

# AMERICAN JOURNAL of PHARMACY

SINCE 1825

A Record of the Progress of Pharmacy and the Allied Sciences

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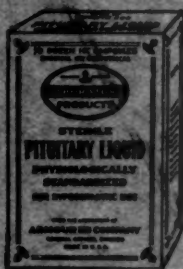
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# THE AMERICAN JOURNAL OF PHARMACY

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## EDITORIAL

### "NEW DAYS, NEW WAYS."

Elsewhere in this issue and everywhere in the medical literature of the day, appear articles dwelling upon some phase or another of this truly remarkable medical adjunct. Not since Ehrlich concluded his search and found his famous 606 had anything really startling happened in the realm of therapeutic discoveries until insulin came. Here and there, of course, a valuable medicinal came to light, but nothing developed in the way of a truly specific remedy.

Out of Canada came insulin—and more romantic even than the birth of the boon is the tale of its quaint introduction. Salvarsan was launched in the usual way, monopolized, price protected and deftly capitalized. Sufferers from the unspeakable disease helped swell the conscienceless coffers of salvarsan's clever backers. The very fact that the pre-war cost per ampule was five to ten times the present cost is proof a-plenty of the heartless profits that came to the German promoters; and this capitalization continued long after a large scale production had brought the manufacturing cost of the material to a negligible figure.

But not so with insulin. In a recent issue of the *International Clinics*, a reputable and valuable medical quarterly, a tribute appears to the method of introducing this remedy to the profession.

This article states as a fact that at this time the only two reliable preparations of insulin manufactured on this continent are those made by the Connaught Laboratory in the University of Toronto, and by an American pharmaceutical house. The latter concern was selected by the University of Toronto to manufacture and distribute insulin (iletin) in the United States, and they deserve great credit for their conservatism and for their strict honesty in placing it on the market.

For at least six months before placing insulin (iletin) on the market they furnished it gratis to about twenty-five

clinicians in the United States, who were selected by the Toronto investigators as being prepared to make blood-sugar and other clinical tests on diabetes with the view of determining the dosage, the effects, the indications for, and the limitations in, the use of insulin in diabetics. These clinicians were pledged not to publish their reports until the Toronto investigators felt there was sufficient data to justify announcing to the medical profession that insulin is of known therapeutic value in the treatment of diabetes. The reports of the use of insulin in a large series of cases by the Canadian, and some of the United States clinicians, were published in the May number of the *Journal of Metabolic Research*. Insulin, therefore, may be said to have passed the experimental stage, and it can be stated as a fact that its use is the greatest advance ever made in the treatment of diabetes.

Both of the Institutions concerned have gone to a great expense in developing methods of purifying and standardizing insulin, and up to this time they both have actually lost money on the insulin that they have manufactured. The price now charged, four cents per unit, is below the cost of production, but it is still every expensive. The average adult daily dose of 30 units costs the patient, for insulin alone, over a dollar a day. It has been stated recently in Toronto by those in charge of the manufacture of insulin in the University of Toronto that as the volume of production increases the cost will be decreased, and that within a year there will be a very material reduction in the price.

Contrary to the German method of exploiting new discoveries in drugs and biological products, the public will be protected in the cost of insulin. The University of Toronto patented the product to insure its reliable manufacture and distribution and their contracts with the American producer provides that the originators of insulin can control the price and that it shall be sold practically at cost, with only a nominal royalty to the University of Toronto, to be used for research in its laboratories. Banting, the discoverer of insulin, has not and will not profit one cent by its manufacture and sale. However, the Parliament of Ontario, in recognition of his service to mankind, has appropriated sufficient funds to endow a Department of Medical Research in the University of Toronto, in which Banting has been given a professorship.

Yet there are those who say that there is no conscience or ethics in any commercial endeavor. Past practices in this particular field on the whole, justify such a contention. Far better, however, than any former effort is the experiment that introduced insulin, for it has already made it possible for the poor as well as the rich sufferer from the dread diabetes to share and share alike in the blessings of this truly remarkable drug.

I. G.



### THE LORE OF CAMPHOR.

The "Romance of Spices" was set forth vividly in a recent paper by Dr. LaWall in this journal. A summary of the folk-lore and superstitions connected with camphor is given in a paper presented to the American Oriental Society by Wilfred H. Schoff, of the Philadelphia Commercial Museum, who is well known for his antiquarian researches in the field of commerce. It seems worth while to present some of the salient points of this communication.

The camphor of antiquity, which was one of the costliest of products, is not of the same source as the common substance. The latter is derived by steaming the leaves, wood and bark of the tree laurel (*Laurus camphora* L) and can also be obtained by synthesis. The precious camphor is a natural accumulation in the light fibrous wood of the *Dryobalanops camphora* Colebrook, a vegetable giant, which, until the discovery of the Sequoias, ranked as the largest type of tree in the world. A tree may be fifteen feet in diameter and two hundred feet high. In height, the type is surpassed by some species of Eucalyptus, which, in Australia, sometimes reach the height of five hundred feet. A large camphor tree may yield only fifteen pounds of the material. Many are felled and cut up to no purpose. Much superstition is connected with the felling of the trees; evil spirits are regarded as being always seeking to cause the disappearance of the camphor. The volatility of camphor at ordinary temperatures has been interpreted by the native races as a definite illustration of the disappearance of the human soul from earth.

Camphor was unknown to the Greeks and Romans of pre-Christian times. No description of it is found in the works of Theophrastus, Dioscorides or Pliny. It is mentioned in writings of the fourth and fifth centuries of the present era, also in a Sanskrit work that Professor Edgerton thinks may be as old as the fourth century, and in a Syriac medical work which may be about the same age. In Syriac, the name is *kapur*, in Greek two forms, *kaphoura* and *kamphora*, occur, but in all the vernaculars of India the name is *kapur* or *kappur*. The earliest literary reference of first rank is in the Koran. In Sura 76, which describes the Mohammedan paradise, camphor and ginger are mentioned as ingredients of cooling drinks for the faithful. (In another Sura it is stated that

the sinners in Hell are given boiling water to drink.) Camphor, as an ingredient of a beverage, seems somewhat strange to us, but Dr. Schoff states that it and ginger are largely used as ingredients of cooling drinks in tropical lands, especially in India. Some fantastic and mystical interpretations of the allusions in the Koran have been made by the Muslim commentators, but need not be noted here. The Arabic form of the word is *kafur*. Mohammed was fond of the odor of the drug, which gave the word great vogue in Islam; among certain Muslims, *Kafur* is a favorite given name.

In the ancient uses of the odorous vegetable drugs, the volatile portions were not employed, inasmuch as distillation is a comparatively recent procedure. The fragrant "ointments" and "anointing oils" of antiquity were fatty oils, such as olive and sesame, scented or flavored by steeping in them the odorous tissues of the plants. The separation of the ingredients of the camphors was not carried out in Europe before the seventeenth century. The natives of the districts in which the camphor-bearing trees are found have curious beliefs that earthquakes and insects have a favorable influence upon the production of the substance, and, according to Assistant Resident Schroeder of Sumatra, the beliefs may have some foundation in fact, for the camphor is found only in cracks and crevices of the wood, which is rather firm, though it splits easily, especially radially, and such splitting occurs occasionally in an earthquake. In order to transform the camphor oil into borneol crystals, oxidation is necessary, and wood-boring insects may afford opportunities for such oxidation.

In this connection, it will be interesting to note a fact in regard to the sandalwood tree. It has long been known that this would not flourish except in association with trees of some other species. It was supposed that the associated trees acted by giving shade, but it was found some years ago at the British Experiment Station of the Madras Presidency (in which the trees grow), that the condition is one of partial root-parasitism. The sandalwood trees send out long slender roots which tap the roots of trees of other species. Phenomena of partial root-parasitism are often noted. The Girardias of North America show the habit, and it is probably more frequent than is commonly believed.

H. L.

## ORIGINAL ARTICLES

### THE MAKING OF MEDICINES.\*

By E. Fullerton Cook.

It is not possible to give consideration to the development of medicines and that of which it is but a minor phase, namely the effort through the ages to relieve humanity from the ravages of disease, without becoming impressed by the spirit of sympathy and the desire to help others, which is the dominant force in the development of the science.

True, the quack, the impostor and the charlatan have always been ready to take advantage of the credulity and need of the sick and will probably continue to exploit those in need until checked by law, but to the honor of those who have gradually perfected the various divisions of the medical arts, history records their nobility of purpose, their untiring and unselfish search for cause and cure and the altruism of their lives of service.

#### Medicines of Primitive Man.

While there is no record carved in stone or handed down in precious parchment to prove the first use of medicines, yet the customs among primitive people, recorded by travelers of our own time, would seem to prove that wherever men and women have lived, they have discovered simple remedies among the growing plants about them. Undoubtedly, the first medicines were herbs, the virtues of which were probably discovered by observing their instinctive use by animals or by actually trying their effect upon themselves or others. In African tribes today and elsewhere that the modern medical sciences have not found their way, the "medicine man" still concocts strange mixtures from herbs and other materials, often of a gruesome or offensive character, yet of supposed magic power, and he administers these to the sick, usually accompanied by elaborate ceremonies and mystic rites, presumably to add efficacy to the cure.

From the earliest dawn of history, the records show that man believed sickness to be caused by an evil or malignant spirit and

\*One of a Series of Popular Lectures delivered at the Philadelphia College of Pharmacy and Science, 1922-1923.

thus entered the religious phase into almost every early attempt to cure the sick.

By empiric methods, that is, by the actual trying out of the effects of various herbs, seeds, roots or other portions of growing plants, often no doubt in teas or decoctions, or the administration of the earths, minerals and metals as they were discovered, there was gradually built up a superficial knowledge of the effects of these upon the body. It was observed that some decoctions would cause emesis or vomiting, others have cathartic action, another would produce diaphoresis or perspiring, while still others were toxic and could cause death as a poison.

About these empiric observations, and the religion of the nations, grew up the schools of medicine, and always there was introduced much superstition and supposed occult power as contributory to the cure.

Probably the earliest written records are those of some sixty centuries ago, when from the oblivion of unknown ages there arose on the banks of the Nile a great civilization.

The fame and ability of a physician of this period, named Imhotep, has been preserved through the centuries. His priestly wisdom, magic, ability to formulate wise proverbs, and knowledge of medicine and architecture, gradually established him, in tradition, as a god, and twenty-five hundred years later the Greeks referred to him as synonymous with their own Æsculapius.



IMHOTEP.

From "The Evolution of Modern Medicine," Osler.  
Courtesy Yale University Press.

In the practice of medicine as developed in Egypt, each physician, who was always a priest, was permitted to practise only his specialty. There were those who treated only the eye, or the teeth, or head or stomach, and they were paid by the government, although fees were also permitted.



A PAGE FROM THE "PAPYRUS EBERS."

From "The Evolution of Modern Medicine," Osler.  
Courtesy Yale University Press.

Through the discovery of the Papyrus Ebers in 1872, which is supposed to have been a collection of formulas of about 1552 B. C. (corresponding to about the twenty-first year of the life of Moses), it is possible to know something of the art of the apothecary of this early period. The remedies used are chiefly herbs, but include lizards' blood, teeth of swine, putrid meat and fat, excreta and other disgusting substances. Among the remedies named are oil, wine, beer, yeast, vinegar, turpentine, figs, pomegranate bark, myrrh, mastic, frankincense, opium, wormwood, aloes, peppermint, cassia, caraway, saffron, linseed, juniper berries, henbane and also some inorganic substances, including iron, lead, magnesia, lime, soda, nitre, vermilion and sulphur. Some of these, of course, have only been guessed at and many other names are given which have not been identified.



Many formulas are simple but others very complex, a poultice, for instance, containing thirty-five ingredients.

A purge was to be made by boiling together one part of milk, and two parts each of honey and yeast. Pills were to be made from equal parts of honey, absinth powder and onion. For the falling of hair, apply a mixture of fats obtained from the horse, the hippopotamus, the crocodile, the cat, the snake and the ibex.

These few formulas will illustrate the *materia medica* of the day and the problems before the pharmacist if he were to meet the demand of the Egyptian physician.

The contemporary Assyrian and Babylonian medicine consisted chiefly of religious incantations intended to drive away the "demons" believed to be responsible for sickness, but also accompanied by the administration of remedies, of which many were in common use.

The Babylonian physician-priest believed that the liver was the centre of life, mind and soul, having observed its size, position and richness in blood in sacrificial animals, and for many centuries this belief was maintained. They also introduced astrology and thought that the heavenly bodies influenced human welfare.

### Hebrew Medicine.

There is little evidence in Jewish literature that medicines in the sense in which we now know them, were used internally. The Pentateuch code provides for social hygiene of an advanced order, following many of the customs and teachings of both Egypt and Babylonia, but surpassing these in some respects. Many diseases were recognized, but the remedy usually depended upon was a miraculous cure through the power of the Lord.

In earlier translations of the Bible the "apothecary" is frequently referred to in the preparation of ointments and ceremonial oils, but in modern translations this is changed to "perfumer."

Many drugs are mentioned as Balm of Gilead, supposed to be the resinous exudation from *Balsamum Gileadense*. The "holy incense" consisted of equal parts of "stacte" (supposed to be myrrh), "onycha" (supposed to be a variety of sea-snail), galbnum and frankincense. This incense was used only for worship in the tabernacle and there was a severe penalty for imitating it. Olive oil was employed for anointing the hair and skin and the "holy anointing oil" contained myrrh, cinnamon, calamus, and cassia in definite proportions, steeped in olive oil. "Aloes" was used as a perfume, but it

was not the drug of today, but probably a perfumed wood from *aquilaria agallocha*, the eagle wood of India.

Wormwood, which produces a bitter flavor, also gall, were referred to by comparison, to indicate something disagreeable. Hysop (not identified), juniper, nitre, mustard seed, vinegar, anise, saffron, pomegranate fruit, figs and spikenard are all mentioned but not as medicines, although a fig poultice, for Hezekiah's boil, is directed by Isaiah.

### China and Japan.

In Chinese and Japanese medicine, for centuries, there were employed many charms and enchantments but also medicinal herbs, parts of animals, animal excretions, etc. The chief dependence for the cure of diseases was placed, however, upon soothsayers and exorcists, who danced in frantic or semi-delirious state, often horribly torturing themselves, that the evil spirits causing sickness might be driven away.

It is interesting to note, however, that the Chinese successfully practised inoculation for smallpox as early as the eleventh century.

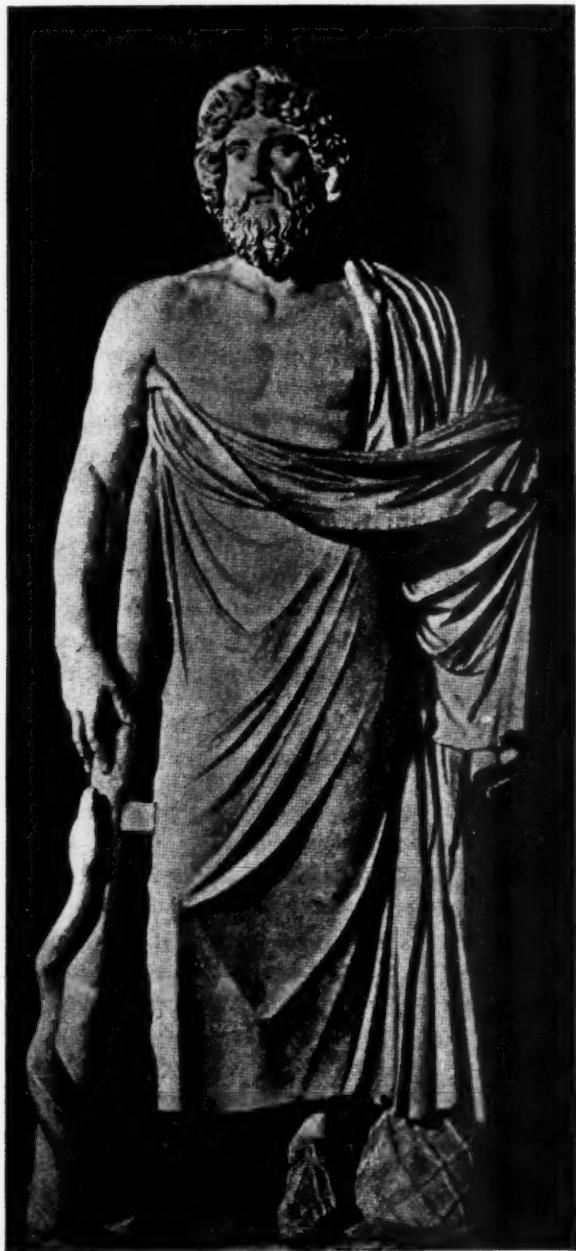
European medicine found its way into Japan about 1770, but only within recent years has modern medicine been extensively introduced into China.

### Greek Medicine.

Apollo was the legendary god of medicine among the Greeks, but his son, Æsculapius, losing his divine attributes, became the emblematic god of healing and with his staff and serpents appears today with many associations of medicine. He is supposed to have lived about 1250 B. C. His sons were also physicians and, according to legend, accompanied the Greek heroes at the siege of Troy. Æsculapius and two of his daughters, Hygeia, symbolic of Health, and Panacea, representing Medicine, were worshipped as gods by the Greeks and Romans for many centuries.

About 300 B. C. between 300 and 400 temples were to be found in Greece, dedicated to him and the healing art. In these temples, where priests presided, great attention was given to diet, exercise, massage, bathing, and, when necessary, drugs were given.

The chief dependence was placed, however, upon the direct aid of the god, and for more than a thousand years the power of Æsculapius was supreme.

**ÆSCULAPIUS.**

From "The Evolution of Modern Medicine," Osler.  
Courtesy Yale University Press.

The true founder of Greek medicine is recognized in Hippocrates, who was born 460 B. C.



**HIPPOCRATES.**

From "The Evolution of Modern Medicine," Osler.  
Courtesy Yale University Press.

The writings attributed to Hippocrates are many, presumably copied from century to century. Naturally it is impossible to definitely separate the authentic from the spurious. The earliest known manuscript is from the ninth century.

The most important information about his writings and treatments came through Galen.

At least 400 substances (vegetable drugs, chemicals, etc.) were employed by Hippocrates and a list of these includes over 200 used in the modern drug shop. Among these are absinthium, althæa, alum, ammoniac, calamus, cardamon, chenopodium, cinnamon, clove, colocynth, coriander, elaterium, euphorbia, fennel, galls, garlic, hemlock, henbane, juniper, licorice, linseed, mercury, myrrh, nitre, oxygall, pennyroyal, pepper, pomegranate, poppy, lime, scammony, squill, stavesacre, sulphur, thyme, turpentine, verdigris and many others.

To Hippocrates is attributed the famous moral code, which has been the creed of physicians for twenty-five centuries.

He was also interested in pharmacy and Galen quotes him as saying, "We know the nature of medicaments and simples, and make many different preparations of them, some in one way, some in another, some simples must be gathered early, some late, some we dry, some we crush, some we cook," etc.

He made poultices, gargles, pessaries, pills, ointments, oils, cerates, eyewaters and inhalations. He is even supposed to have made tablets or lozenges in different shapes, one square from antimony, another triangular, each for a specific purpose.

The great name in Greek medicine following Hippocrates was Galen, born A. D. 130, and his name is also immortalized in pharmacy through its application to the general class of medicines known as "galenic preparations," including tinctures and wines of vegetable drugs, etc. It was during the period of his life that pharmacy was greatly developed, especially the art of compounding.

An illustration of a compound used for cholera, commended by Galen, is: Henbane seed, 2 drachms, Anise, 1 drachm, Opium,  $\frac{1}{2}$  drachm, made into 30 pills.

Another for coughs was 4 drachms each of the Juice of Hemlock, Juice of Henbane, Castorum, White Pepper, and Costus, and 1 drachm each of Myrrh and Opium.

The medical practice, up to the beginning of the sixteenth century, was largely that taught in this Greek School.



The practice of pharmacy, however, was extensively developed during this period, especially by the Arabs.

The work on chemistry, attributed to Geberand and his associates in the eighth century, stands as a monument to the Arabian genius.

To the pharmacy of the Arabian School is credited the development of the use of alcohol as a solvent. They introduced sugar, syrup, rhubarb, senna, camphor, manna, musk, nutmegs, tamarinds and other drugs. They first distilled rose water and first established pharmacies as separate from the physician's office, thus giving to pharmacy a new dignity.

Paracelsus, early in the sixteenth century, was the first to materially add to the Hippocratic-Galenic School of Medicine. He made many important chemical studies, discovering zinc, a number of compounds of mercury, including calomel, also flowers of sulphur, and urged the use of preparations of iron and antimony.

Perhaps his greatest reputation was due to the introduction of tincture of opium (laudanum) with which he seemed to effect miraculous cures. His work stimulated important study in chemistry and pharmacy, and little by little, through the succeeding centuries, the knowledge of drugs and their uses increased and the foundation was laid for the tremendous advance of the last fifty years.

Gradually superstition and the belief in the miraculous power of certain medicines has been swept aside.

Several of these older remedies have enjoyed a reputation covering many centuries and several were considered essential for the practice of medicine, even up to the eighteenth century.

Four of the most important were Mithridatum, Venice Treacle or Theriaca, Philonium and Diascordium. Galen gives the formulas. That of Theriaca was supposed to have originated with Nero's physician, Andromachus.

Mithridatica contained 47 and Theriaca 62 ingredients, modified formulas for the two preparations being found as late as 1746 in the "London Pharmacopœia."

Philonium was really a confection of opium, but contained many other ingredients. It was used for colic and in modified form remained in the "London Pharmacopœia" until 1867.

Diascordium, used as a preventive of plague, was accredited to Frascatorius and continued to be used during the eighteenth century, becoming a popular household opiate.

It is interesting to note that these four preparations all con-



From "The Evolution of Modern Medicine," Osler.  
Courtesy Yale University Press.

tained opium. For centuries Theriaca or Treacle was made almost exclusively in Venice, but in 1585 the apothecary to the English Queen claimed that he was able to produce a product equal to that made in Venice or Constantinople.

The antiquity of some medicines used today is shown by the dates of their origin.

*"Black Draught"* (Compound Infusion of Senna) was originated about 1600 by an Italian physician, Mannogetta.

*Blaud's Pills*—Proposed by Dr. I. Blaud in 1831.

*Citrine Ointment* (Mercuric Nitrate) first noted in the "Edinburgh Pharmacopœia" about 1722.

*Cold Cream*—Attributed to Galen.

*Diachylon Plaster* (Lead Plaster).

The formula was originated by a physician of the Caesars, Tiberius Claudius Menecrates.

*Dover's Powder* (Powder of Opium and Ipecac) was originated by Dr. Thomas Dover, born in 1660.

*Fowler's Solution of Arsenic*—Published by Dr. Thomas Fowler in 1786.

*Gregory's Powder* (Comp. Powder of Rhubarb) was frequently used by Dr. James Gregory, who died in 1822.

*Hiera Picta* was sold in Rome and Alexandria 2000 years ago and is yet in the "National Formula" as Powder of Aloes and Canela.

*Paregoric*—Originated by Le Mont at the University of Leyden in 1702.

*Plummer's Pills* (Pills of Antimony)—The formula published by Dr. Plummer in 1751.

### The Medicines of Today.

During the latter part of the nineteenth century and in the past two decades, the inherited beliefs and the empiric evidence in the potency of the medicines of our fathers have been subjected to careful scientific study and test.

Some failed to prove their therapeutic value and have been abandoned. A few, at first condemned, were later found, through newly discovered methods, to fully justify the faith and clinical evidence of the older physicians. Cod liver oil is a striking illustration of this group, the recent vitamine discoveries having scientifically demonstrated a basis for its value.

The searching analysis of the twentieth-century seeker for truth has found in other older remedies the vital principles which possessed definite and dependable physiologic action. In such medicines an earnest effort has been made to provide forms for administration which will be reliable—which will always produce a specific action and, so far as possible, in the same degree.

This has meant the manufacture and further purification of many well-known chemicals, that they may conform to established standards and contain no foreign or deleterious impurities. It has also required the development of ingenious methods for determining the amount of active constituents which were found to exist in some vegetable and animal drugs and also the separation and purification of some of these constituents for separate administration, as illustrated by quinine, the alkaloid for cinchona bark and epinephrine from suprarenal glands.

In other cases, when drugs were known to produce definite action upon the human body and upon animals, but no constituent could be separated chemically to represent that power, it was necessary to devise other methods of assay, involving a study of their action upon animals, that preparations might have uniform and assured physiologic activity.

Thus has the scientist in the pharmaceutical field, with his modernly equipped laboratory, and numerous original investigations, provided preparations of the older remedies which are more dependable and possess greater uniformity of action than was formerly possible.

New methods of administration have also been devised both for convenience and greater efficiency.

Medicines in capsules and tablet form have gained great popularity, largely because of convenience, and the preparation of medicinal agents in sterile solution or mixtures, dispensed in ampuls, for intramuscular or intravenous injection, have been found by many physicians to be the more efficient method of drug administration.

In addition to improvements in the quality and reliability of the older remedies and in the methods of their administration, the search for new medicines, especially specifics, has been conducted untiringly by research workers throughout the world and has resulted in the development and introduction of hundreds of new remedies.

In the field of Organic Chemistry, the so-called "Coal-Tar Synthetics" were among the first to prove their value as medicines. Many of these products were developed in research laboratories abroad and were exploited commercially with enormous profit to those who controlled the process patents or trade-marks. The natural result of this condition was a tremendous stimulation in research and also the exploiting of many products of little or no value and even the introduction of dangerous or habit-forming drugs.

Out of this maze of "Newer Remedies" a few have survived the acid-test of time, among them antipyrine, phenacetine, acetylsalicylic acid (aspirin), atophan, all now official, and many others, some of which are spoken of more in detail in the following summary:

### **Hypnotics.**

Early in the study of synthetic remedies, substances were discovered which induced sleep without apparently possessing the habit-forming and other objectionable characteristics incident to the use of opium. Trional and sulphonal were long used and are now official. Other products are also now largely employed, as barbital or veronal, barbital-sodium, luminal and luminal-sodium.

Another group of hypnotics is represented by the official hydrated chloral and also by a number of synthetic chloral compounds, for which special advantages are claimed. Among these are butyl-chloral hydrate, chloralformamide, and chlorbutanol.

### **Arsenic Compounds.**

In the search for specifics for well-defined diseases, it had been demonstrated that arsenic in certain organic combination could be given in doses which would kill organisms of the protozoa type and yet remain non-toxic to the human body.

A number of combinations of this character had been developed, including sodium cacodylate, but it remained for Ehrlich to produce Salvarsan and Neosalvarsan, well-known in this country as Arsphenamine and Neoarsphenamine, which have proven of inestimable value in the treatment of syphilis, and have been employed successfully in other spirillum affections, such as relapsing fever and malaria.

### **Anesthetics.**

The importance of the discovery of Ether and Chloroform, whereby painless operations were made possible, cannot be over-



estimated. Much of the development of modern surgery was made possible through their use.

Other general anesthetics have been introduced, such as ethyl bromide, but ether is still most generally employed.

It has been found possible to use a local anesthetic in minor operations and for this purpose the alkaloid cocaine was long used.

Many synthetic products are now being offered, however, under trade-marked names, various advantages being claimed, such as their being non-habit-forming, or less toxic, etc. In this group may be mentioned butyn, novocain, procaine, holocaine, stovaine, benzocaine, apothesine, and many others.

#### **Tannin Combinations.**

Tannin compounds which will not dissolve in the stomach as would tannic acid, but which will liberate tannic acid in the intestines, used chiefly for the treatment of diarrhoea, are among the developments of the modern research laboratory.

In this group are found acetannin, albutannin, protannin, etc.

#### **Antiseptics.**

The exigencies of the great war required more efficient antiseptics than those available and there were developed a better technique in the treatment of wounds, more effective forms for well-known antiseptics and also new and more powerful products.

In the latter group, certain substances closely related to the coal-tar dyes were found to possess powerful germicidal action. Those which have been most effectively used are known as acriflavine and proflavine.

Of the older antiseptics, chlorine was made available in non-irritating form, largely through the extensive researches of Carrel and Dakin. The so-called Carrel-Dakin Solution, a slightly alkaline solution of chlorinated soda, containing from 0.38 to 0.48 per cent. of available chlorine and the later chlorine-liberating products known as "chloramine-T" and "dichloramine-T," used as antiseptics or wound treatment, were notable developments of the war. The product halazone, for the purification of drinking water, also proved to be of great value.

Mercury bichloride has been for many years the standard antiseptic and germicide, but other less irritating compounds of mercury have also been developed, such as mercurochrome, mercuriol, mercuric benzoate, mercuric cyanide, mercuric oxycyanide, mercuric salicylate, mercuric succinimide, etc.

Silver nitrate, also one of the older germicides, was always limited in its use because of its caustic action. Organic combinations of silver have been developed, however, which possess special merit as antiseptics, without being caustics. Among these are protargol, argyrol, cargentos, collargol, etc.

### Urinary Antiseptics.

One of the developments of the synthetic laboratory has been the valuable urinary antiseptic hexamethylamine, in which the well-known antiseptic action of formaldehyde is made available by an organic combination, which permits its administration without irritation. Decomposition and the liberation of formaldehyde occurs during its secretion, if the urine is acid.

### Animal Products.

The *bile salts*, sodium glycocholate and sodium taurocholate, and also the purified extract of ox-bile, have maintained a definite place in modern medicine as a stimulant to the activities of the liver. Highly purified products, suitable for administration by the mouth or for injection, have been developed by the modern pharmacist.

The *digestive ferments*, consisting of the active digestive enzymes, pepsin, amyllopsin, trypsin, etc., separated from the stomach or pancreas of the hog, have found a useful place in modern medicine and are available in concentrated and highly purified form.

The so-called "*ductless glands*" have recently assumed an important place in medicinal treatment.

The action principle of the suprarenal gland, known as epinephrine, has fully established itself and now the active principle of the thyroid gland, known as thyroxin, is also available.

The dried thyroid and pituitary glands have also found a definite place in the materia medica and study is being made of ovarian substance, the parathyroid gland and others.

### Blood Clotting.

This phenomena, familiar to all, is due to a ferment, known as "thrombin," normally present, acting upon the fibrinogen of the blood. Substances which stimulate this action, useful in hemorrhages, have been prepared from the brain of cattle and are sold as brain lipid, thromboplastin, kephalin, etc.

### **Serums and Vaccines.**

This group of biologic products probably stands at the peak of modern achievement in the fight to conquer disease.

Diphtheria antitoxin occupies the foremost place, since its introduction and development has made it possible to control and often prevent that dread child disease. Antitetanic serum has also proved its efficiency, especially as a preventative of tetanus and, probably saved more lives during the war than all that were lost. Many other serums are being used and their value and new application is constantly being extended. Among these are antianthrax, antidyenteric, antigonococcus, antimeningococcus, antipneumococcus, antistreptococcus, etc.

In addition to these substances, which produce active immunity, that is, in themselves neutralize the toxic poisons from disease, there are others which stimulate the development of antitoxins, within the body of the patient. This is known as "passive immunity."

The best-known of this group is vaccine virus to prevent small-pox.

The effectiveness of this treatment in the prevention of small-pox has been so fully demonstrated that, by the law of all civilized countries of the world, every man, woman and child must be "vaccinated."

Other substances of the passive immunity type, known as bacterial vaccines, are also extensively used. The best known is probably the typhoid vaccine, which is credited with having almost eliminated that former dread disease from our army camps. It is also marked for the treatment of many other diseases caused by bacterial infection, such as acne, cholera, gonococcus, meningococcus, pertussis (whooping cough), plague, pneumococcus, staphylococcus, streptococcus, etc.

### **Proteins.**

In recent years it has been discovered that the cause of hay fever, asthma and other systematic disturbances are the result of irritation from various protein substances. These are frequently the pollen of plants, but it has been shown that some persons are sensitive to many other forms of protein which may be found floating in the air or taken as foods.

Solutions of various proteins are being employed as diagnostic

reagents, as the patient can often avoid contact with the protein substance when the specific cause of irritation is determined.

Solutions of soluble constituents from these proteins are also being injected for the purpose of developing immunity.

#### **Leprosy and Chaulmoogra Oil.**

The heroic searchers for the cause and treatment of the dread disease "leprosy" have at last discovered a remedy which has cured many cases and at last promises hope that the world may be freed from this scourge. Chaulmoogra oil was first used, but the research worker has found that the active ingredients can be prepared as the ethyl esters of the fatty acids of the oil, and that in this form the remedy may be used hypodermically and much more effectively.

#### **Radium.**

This summary of modern medicines would not be complete without mention of the marvelous element "radium," the rays of which are now so extensively employed in the destruction of pathogenic tissues.

It is marketed today largely in the form of its salts, the bromide, carbonate, chloride and sulphate.

The number of "Newer Remedies" which have been introduced to the medical profession during the last two decades is almost legion. Only a limited number have survived and of these but a few representatives have been named to illustrate their varied character.

While now and again a remedy will be exploited with but little consideration other than the financial return, this is less and less true. Research only a few years ago was largely conducted by commercial houses who were compelled to reimburse themselves for the enormous cost of research by selling the product. Today many other groups are conducting research, often under large endowment, and a better condition has developed in which such products are being marketed by commercial houses, under license, but the control still retained by the research organization, the license being granted to more than one manufacturer and distributor.

Two recent products so controlled are thyroxin, the active principle from the thyroid gland, developed at the University of Minnesota and licensed for manufacture and sale to a commercial house. Another is the much-talked of "insulin," for the treatment of diabetes, developed at the University of Toronto and being similarly marketed.

In presenting this summary of the medicines of our forefathers and of today for a popular evening talk, the treatment has been necessarily brief, and far from complete. Many of the illustrations shown on the occasion, which it has not been possible to reproduce here, were supplied by manufacturing pharmaceutical and chemical firms and appreciation for their courtesy in supplying these is hereby expressed.

The historical slides were prepared for the occasion from old prints and illustrations collected from many sources. Other slides illustrated the modern cultivation of medicinal plants on a commercial scale, including cinchona forests, the manufacture of chemicals, pharmaceuticals and biologicals, including the extensive animal farms incident to serum and vaccine production, and pictures of huge stocks of chemicals, galenicals and serums, and of the extensive laboratories required to analyze the raw material and standardize the products were also elaborately illustrated. These latter pictures were supplied by Burroughs, Wellcome and Company, Johnson and Johnson, Powers, Weightman, Rosengarten Co., H. K. Mulford Co., Eli Lilly and Co., E. R. Squibb and Sons, Sharpe and Dohme and Parke, Davis and Co.

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## HISTOLOGY AND CHEMISTRY OF THE AVOCADO.\*

By W. J. Stoneback† and Ralph Calvert.†

With the introduction of the avocado into Florida and California a valuable edible fruit has become available for all those who can learn to relish it. To appreciate the esteem in which it is held, especially by the aboriginal inhabitants of tropical America, one needs only to read the following quotation: "Four or five tortillas (corn cakes), an avocado, and a cup of coffee—this makes a good meal." To North American horticulturists the avocado represents one of the greatest future sources of fruit which the tropics offer at the present day. But to the inhabitants of Mexico and Central America it is a realized possibility.

This fruit does not as yet enjoy as great a patronage in our own markets, partly because we are unfamiliar with it and also

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on account of its high cost, especially in our northern markets. Until all the problems of propagation, culture, and marketing have been solved the cost is bound to remain at a fairly high figure.

The avocado is yielded by two of the Lauraceæ, *Persea gratissima* (Gaert) and *P. drymifolia* (Cham. and Schlecht).



Fig. 1—The Collins. A variety of Guatemalan Avocado.

The classification of the cultivated avocados into three races has been useful in bringing together all varieties similar in character. In the mention of one of the races, one immediately thinks of the relative hardness, season of ripening and commercial char-



Fig. 2—Longitudinal view of fruit, showing seed embedded in one-half of cavity.

acter of the fruit, it being necessary only to understand the time of ripening, the relative thickness of the fruit skin and whether the leaves of the plant are anise-scented, the leaves of the Mexican avocado being the only ones which are anise-scented. The time

of ripening of fruits of the West Indian race is given as summer and fall; the Guatemalan, as winter and spring; and the Mexican, as summer and autumn.

The skin of the fruits of the West Indian variety is rarely more than 1.5 mm. in thickness and leathery in texture; that of the Guatemalan varies from 1.5 to 6 mm. and is woody in texture; while the skin of the Mexican race is rarely over .75 mm. in thickness and membranous in texture.



Fig. 3—The seed of the Collins variety.

There seems to be some doubt as to which part of the tropics the avocado is native, but Jacques Huber, in the *Boletim do Museu Goeldi*, says: "Everything indicates that the avocado, originally indigenous to Mexico, has been cultivated since immemorial times, and that it very early spread through Central America to Peru; then into the Antilles, where its introduction is mentioned by Jacquín; and much later into Brazil."

The earliest account so far available concerning the avocado, is contained in the report of Gonzalo Hernandez de Aviedo (1526), who saw the tree in Colombia.

Pedro de Cieza de Leon, a traveler through tropical America between 1532 and 1550, mentioned the avocado as one of the fruits used by the Spaniards who settled in the Isthmus of Panama, and as being an article of food among the Armi and Cali in Colombia.

Francisco Cervantes Salazar, one of the earliest chroniclers of Mexico, in his "Mexico en 1554," shows that the avocado was well known in the markets of Mexico City as early as 1554, which was very soon after the Conquest. Later, in his "Chronica de

Nueva Espana," written about the year 1575, he described the fruit. In both his works, he used the name Aguacate.

Garcilasso de la Vega, writing in 1605, states that the name palta was applied to this fruit by the Incas, who brought the tree from the province of Palta to the Valley of Cuzco.

A more accurate account was written in 1653 by Bernabe Cobo, a priest who had traveled extensively in tropical America. He was the first to mention the Guatemalan avocados. After describing at some length the West Indian race, as it is now called, mentioning in particular the varieties grown in Yucatan and those of certain sections of Peru, he says: "There are three kinds of paltas. The second kind is a large, round one which is produced in the province of Guatemala, and which does not have as smooth a skin as the first. The third is a small palta which is found in Mexico which in size, color and form resembles a Brea fig; some are round and others elongate, and the skin is as thin and as smooth as that of a plum." Thus as early as 1653, Padre Cobo distinguished between the three races which are now recognized by horticulturists under the names of West Indian, Guatemalan and Mexican.

Sir Hans Sloan, in his "Catalog of the Plants of Jamaica," published in 1696, briefly describes the avocado, cites numerous works in which it is mentioned, and gave it its now common name, "The Avocado or Alligator pear-tree."

The Aztec Indians called the fruit the ahuactl, then after the settlement of the country by the Spaniards various adaptations came into vogue such as ahuacate and aguacate. The Spaniards, who introduced the avocado into Jamaica, took with them the Mexican names. After the seizure of Jamaica by the English, the name began to undergo a process of corruption, when forms as albecata, avigato and avocato were developed. G. N. Collins lists forty-three common names for this fruit, many of which are of limited use, others the slipshod efforts of early writers to spell the names as they heard them.

The term "pear" was frequently added to the various corruptions, which was a tendency of the early English colonists in applying familiar names to the fruits which they found in America. The term "Alligator-pear" is a misnomer and is to be discouraged. In the first place the avocado does not bear any semblance to an alligator and secondly the fruit is not a pear, but a drupe. The term "Alligator" alone induces an instinctive dread in the minds of many people, and for that reason many decline to eat it.

The correct English name is now recognized to be Avocado. Vegetable Butter and Midshipmen's Butter are two common names applied to the fruit.

### Introduction.

Clusius,\* in 1601, states that the avocado is an American tree introduced into a garden in Spain.

De Candolle† mentions its introduction into the Sunda Isles in the middle of the eighteenth century, while Aublet indicates its introduction in 1750, into Mauritius and Bourbon.

The first introduction into Florida, of which a record has been found, was in 1833, when Henry Perrin sent trees from Mexico to his grant of land below Miami, although it is generally believed that it was introduced by the Spaniards at an earlier date.

The first record of its successful introduction into California dates to 1871, when R. B. Ord brought trees from Mexico and planted them at Santa Barbara.

Higgins, Hunn and Holt give 1825 as the year of its introduction into Hawaii, although it did not become common until 1853. In the Philippines its culture has been established since the American occupation, many varieties having been introduced by the Bureau of Agriculture. The avocado is now being cultivated to a limited extent in Algeria, southern Spain, France, Reunion, Madagascar, Polynesia, Tahiti, northern Australia, Natal, Mauritius, Maderia and the Canary Islands.

"It finds its greatest importance as a food in tropical America, where it is equally relished as such by birds, man and beast. The inhabitants feed the fruit to hogs for fattening, on account of the delicate taste it imparts to the flesh. The leaves are considered balsamic and pectoral in the West Indies and an infusion of the buds has been recommended in the treatment of syphilis and as a cure for bruises."‡

In tropical America seedlings of this plant are common in door-yards, thriving with no attention whatever. As an orchard crop it has never been developed, but this is common in these countries, because orchards of fruit trees are a scarcity in the tropics. Its introduction into localities other than its native home

\*Popenoe: "Manual of Tropical and Subtropical Fruits," pp. 1-77.

†DeCandolle: "Origin of Cultivated Plants," p. 292.

‡Sargent: "The Silva of North America," Vol. vii, p. 2.

is of greater consequence. Here cultivation is necessary, taking into consideration the following factors: Topworking of old trees, grafting, budding, irrigation, fertilizing, mulching and cover-crops. In topworking old plants the limbs are cut off within a foot or two of the trunk, the cut surface being covered with a liberal coating of grafting wax. The best time for cutting back trees in Florida is from November to December, and in California from February to March. When growth again begins, sprouts appear around the upper ends of the stubs. Three or four are allowed to remain on each stub, and when these have reached a certain diameter, they are budded in the same manner as seedlings, with a large bud, from growth which is immature. Cleft grafting is another method employed in topworking old trees, and is most successful with seedlings 2-4 years old, but is often used on older trees. Avocados do not develop true to seed (seedlings of various varieties producing fruits, other than their own characteristic ones). In this case it is necessary to resort to budding and grafting, to insure fruits of a uniform commercial quality.

The seasons at which fruits of cultivated commercial varieties ripen in California, are the following: Spring varieties—Fuerte, Spinks, Blakeman and Lyon; Summer varieties—Spinks, Blakeman, Lyon, Dickinson and Taft; Fall varieties—Taft, Dickinson and Sharpless; Winter varieties—Sharpless, Puebla and Fuerte.

In Florida the fruits are available according to the following seasons: Earliest varieties of the West Indian race begin to ripen in July, while seedling crops mature in August and September. The Guatemalan varieties begin to ripen approximately in November and continue until May. From the foregoing outline, as indicated for the Florida ripening seasons, the Guatemalan appears to be the most profitable to propagate, because of their maturation during the winter months, when fruits are desirable and bring a higher price.

In gathering avocados they are best picked with orange clip-pers. The stem is usually swollen just above the point of attachment with the fruit, and in picking they are severed just above the swollen portion. The practice of picking fruits before maturity is discouraged by the various associations of avocado growers, and they now recommend gathering the fruits a few days before dropping, and laying aside any questionable fruits for a period of twenty-four hours. If they remain firm, they may be safely packed for shipment. For shipment orange crates have been used to good

advantage. Excelsior is placed between each layer of fruits, and is also stuffed between them to prevent bruising. The fruits have been wrapped individually, but this is not advisable on account of the rapid heating, which hastens the ripening process.

### Description and Habit of Tree.

Seedling avocados vary in habit of growth, some short, some spreading, but more commonly erect, even slender.

Some attain a height of thirty feet when grown in shallow soil, others attain a height of sixty feet when grown in deep moist clay-loams. When budding or topworking is resorted to, a tree of much smaller habit is produced.

The leaves vary in form from lanceolate, elliptical, ovate to obovate and measure from three to sixteen inches in length. The apex, blunt to acuminate; base, acute to truncate.

The flowers are produced in axillary racemes, small in size, pale green or yellowish green in color. The flower (Fig. 1) shows six perianth lobes, slightly unequal in size and lanceolate to ovate in form, pubescent in *P. drymifolia*, sometimes glabrous in *P. gratisima*, the androecium of nine stamens arranged in three series, the anthers four-celled, which open by small valves hinged at the apical end, and filaments which have two large orange-colored nectar glands at their base; a gynoecium comprising a single pistil composed of a simple stigma, a pubescent style, and a one-celled ovary containing a single ovule.

### Fruit.

The fruit in both species is a drupe varying in shape from pyriform, ovate, obovate, spherical, oblate to slender. Its color varies from yellowish green, almost yellow, to crimson, maroon, brown, purple to almost black. It weighs from two ounces to four pounds.

### Description of the Fruit.

The following description applies only to the one fruit used for the writers' examination, *e. g.*, the "Collins." Form, obovate-pyriform; size, medium; weight, 400 grams; length, 114 mm.; greatest diameter, 89 mm.; base, slightly rounded, with remains of short stout stem inserted into a shallow cavity; apex, rounded; surface, smooth toward base, verrucose toward apex; color, yellow to yellowish green, with numerous brown spots, fruit on ripening becoming reddish brown; skin, 2 mm. thick, separating readily



from the fruit flesh; fruit flesh or mesocarp, having consistency of butter at ordinary room temperature, and possessing a rich oily pleasant flavor, colored yellowish toward seed, greenish toward skin; seed, rounded-conical; 60 mm. in height and 54 mm. at greatest diameter, weight 108 grams, fitting tightly in seed cavity, and having a single seed-coat firmly adherent to seed.



Fig. 4—Cotyledons parted, exposing plumule. (p) Plumule.

On dissection of the fruit, the large rounded-conical seed was exposed, firmly embedded in the seed cavity, surrounded by the edible mesocarp. Numerous strands of brown fibrovascular bundles were found to ramify through the mesocarp from base to apex. The color of the mesocarp varied from yellow to light green and was oily and mucilaginous to touch. The seed is exalbuminous. On dissection of the seed it was found that the endocarp, consisting of a layer of stone cells, was firmly adherent to the spermoderm. Fragments of mesocarp were found to be adhering to the endocarp. On removal of the spermoderm, two white to pinkish cotyledons were exposed. These were corrugated toward the apex along their margin of contact. On separation of the cotyledons they were found to be unequal in size, convex on outer and concave on inner surface. A small embryo is embedded for the greater part in the large cotyledon about one-fourth of the distance from the base to the apex, through the longitudinal axis. The plumule was plainly evident on microscopic examination.

#### Histology of the Fruit.

1. *Pericarp.* (Fig. 5.) In transverse section the epicarp shows three distinct regions, first a layer of rectangular suberized cells, whose radial and outer walls are evenly thickened. Beneath the layer of suberous cells a layer of tangentially elongated cells are

noted. The second region consists of a layer of from six to ten parenchyma cells, containing chlorophyll and numerous yellow oil cells having suberized walls. The third region is composed of from

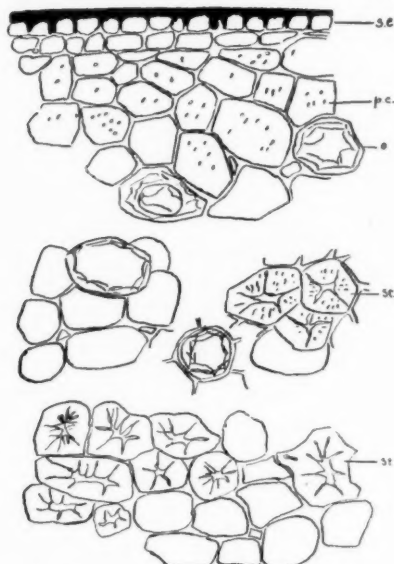


Fig. 5—Part of a transverse section of epicarp. (o) Oil cell, (p. c.) parenchyma containing chlorophyll, (s. c.) suberized cells, (st.) stone cells.

five to ten layers of cells, scattered among which are numerous radiating-pore-canal stone cells arranged either singly or in groups of from three to seven. The general outline of the cells of the epicarp is from rectangular to irregularly rounded. Spherical as well as rectangular oil cells were observed. The stone cells are irregularly rounded to rectangular.

2. *Mesocarp.* (Figs. 6 and 7.) In passing into the mesocarp region parenchyma cells modified as oil secretion cells with suberized cell walls, and mucilage cells are to be noted. The contents of the mucilage cells give the characteristic reaction with alcoholic methylene blue test solution. Scattered through this region are also to be found numerous strands of fibrovascular bundles of the open collateral type.

3. *Endocarp.* (Fig. 8.) The inner region of the pericarp consists of a layer of stone cells, firmly adherent to the spermoderm. This leads to the conclusion that the fruit is a drupaceous one, since a drupe is a fruit with a stony endocarp.

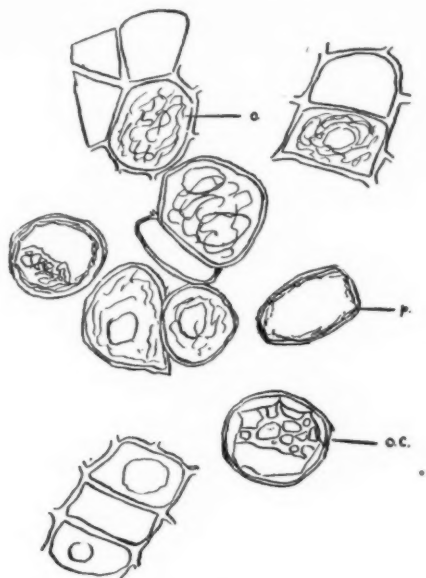


Fig. 6—Parts of a transverse section of the mesocarp. (m) Mucilage cell, (p.) parenchyma cells, (o. c.) oil cell.

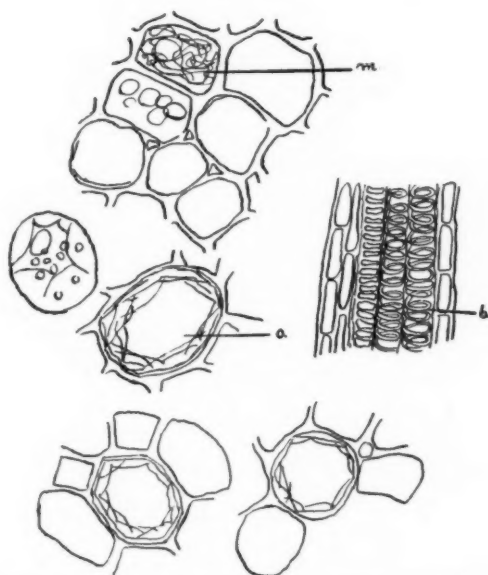


Fig. 7—Parts of a longitudinal section of the mesocarp. (m.) Mucilage cell, (b.) f. v. b. showing spiral tracheae, (o.) oil cell.

4. *Spermoderm*. (Fig. 8.) The spermoderm consists of three regions, the first the outer epidermis made up of a layer of large rectangular cells the lumina of which are filled with a brown coloring principle. The middle region is made up of several layers of

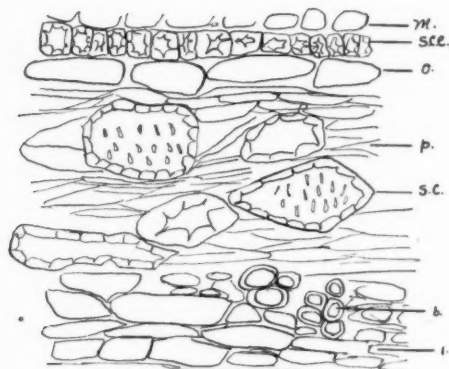


Fig. 8—Part of a transverse section of the spermoderm. (b.) Part of f. v. b., (i.) inner epidermis, (m.) cells of mesocarp adhering to endocarp, (o.) outer epidermis composed of giant cells, (p.) loose parenchyma cells, (sc.) stone cells, (s.c.) stone cells of endocarp.

loosely arranged, sometimes compressed, elongated cells with numerous rectangular to elongated, lignified stone cells scattered unequally among them. Through this region are also found strands of fibrovascular bundles embedded for the greater part nearest to the inner epidermis. The inner epidermis consists of two layers of colorless elongated cells.

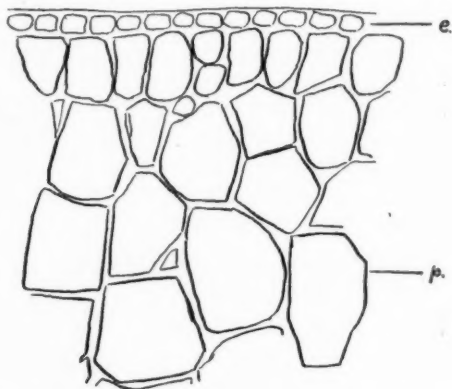


Fig. 9—Part of transverse section of outer epidermis of cotyledon. (e) Epidermal cells, (p.) parenchyma cells of mesophyll.

5. *Cotyledons.* (Figs. 4, 9, 11.) The cotyledons in transverse section show a layer of small, rectangular epidermal cells. On treating a section with Ferric Chloride Test Solution occasional cells, subjacent to the epidermis, take a black color, which indicates the presence of tannin. The majority of cells of the mesophyll are completely filled with starch, other cells being modified as oil cells with suberized walls. Fibrovascular bundles are evident coursing through both cotyledons.

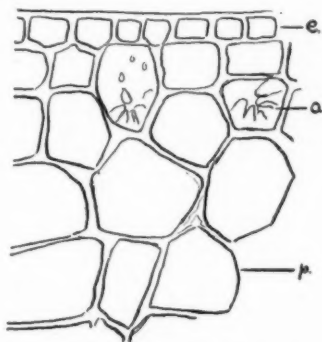


Fig. 10—Part of transverse section of inner epidermis of cotyledon. (e.) Epidermal cells, (o.) oil cell, (p.) parenchyma cells of mesophyll.

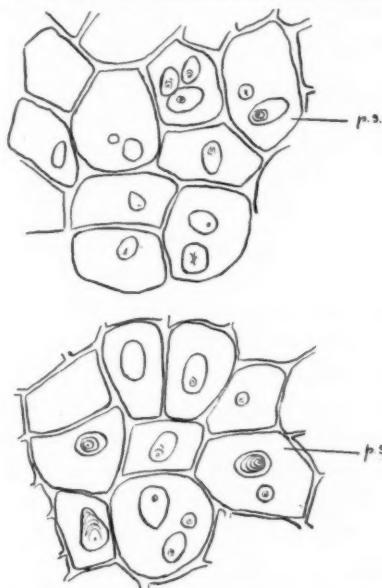


Fig. 11—Part of transverse section of mesophyll. (p. s.) Parenchyma cells filled with starch.

6. *Description of Starch.* (Fig. 12.) The greater number of starch grains are simple, two-compound grains being noted only among the smaller grains. They vary in size from 4.1 to 41 microns and in shape from round, elliptical, truncate to irregularly rounded. The hilum is distinctly cleft in the largest grains, and is found toward the broad end. In the smaller grains the hilum is round

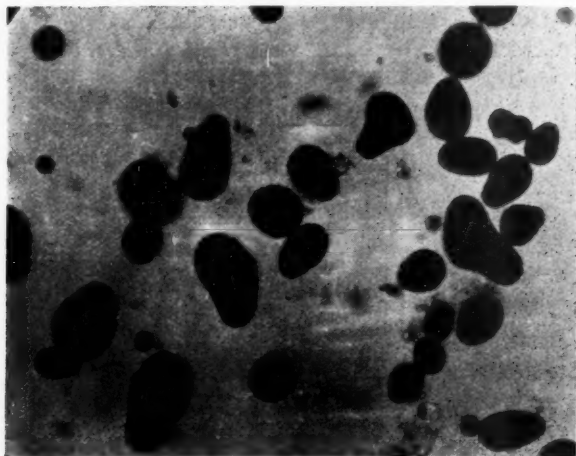


Fig. 12—Photomicrograph of starch stained with Iodine T. S.

and in the center. The lamellæ are concentric and eccentric, distinct. The polarization cross is distinct, but no marked play of color is noted with the selenite plate.

The fruit used for the writers' examination was the "Collins," a variety of the Guatemalan race, furnished by Mr. Wilson Popenoe, Agricultural Explorer, U. S. Department of Agriculture. The writers are indebted to Mr. Popenoe for many of the historical and chemical references and data contained in this paper gathered from his "Manual of Tropical and Subtropical Fruits."

It may be expedient, before taking up the Chemical Analysis of the avocado, to explain that the proportions of the constituents have been found to change in each variety according to the degree of the maturity of the fruits. They may fluctuate also in different years. Variation is particularly noticeable in regard to the fat content. Up to a certain point, the fat content increases with the maturity of the fruit.

The total dry matter in the edible portion of the avocado is greater than in any other fresh fruit, the one nearest approaching



it being the banana, which contains about 25 per cent. The avocado contains an average of 30 per cent.

The protein content, which averages about 2 per cent., is higher than any other fresh fruit.

The percentage of carbohydrates is not high compared with many fruits, because the avocado contains almost no sugar. F. B. LaForge, of the Bureau of Chemistry at Washington, has found a new sugar in the avocado, called *d*-Mannoketoheptose, believed to be present in varying amounts from 0.5 to 1 per cent.

The amount of mineral matter is much greater than in other fresh fruits. Salts of sodium, potassium, magnesium and calcium compose more than one-half of the ash. This fact places the avocado among the foods which yield an excess of the base-forming elements, as opposed to nuts, which furnish an excess of acid-forming elements.

The chief value of the avocado as a food is due to its high percentage of fat, averaging 20 per cent. Experiments carried on at the University of California show that the digestibility of fat from the avocado is equal to that of butter fat, and not below that of beef fat.

The caloric or energy-producing value of the avocado is very high. One pound of the edible portion represents an average of 1000 calories. The maximum yield is nearly twice that of average lean meat.

In comparison with some common foodstuffs, the calorific value of the avocado is here shown:

100 grams boiled rice .....	322 calories
100 grams white bread .....	246 calories
100 grams avocado .....	218 calories
100 grams egg .....	166 calories
100 grams lean beef .....	100 calories

It must not be assumed that the avocado has a total food value twice that of lean meat, for much of the food value of meat lies not in the energy which it produces, but to its ability to build up the tissues of the body.

The following table from the work of M. E. Jaffa, of the University of California, and taken along with most of the foregoing data from the "Manual of Tropical and Subtropical Fruits," by Wilson Popenoe, Agricultural Explorer, United States Depart-

ment of Agriculture, shows a comparative analysis of several well-known varieties of the avocado and the hybrid Fuerte:

<i>Variety</i>	<i>Moisture</i>	<i>Protein</i>	<i>Fat</i>	<i>Carbo- hydrates</i>	<i>Ash</i>
Trapp . . . . . (West Indian)	78.66	1.61	9.80	9.08	0.85
Sharpless . . . . . (Guatemalan)	71.21	1.70	20.54	5.43	1.12
Puebla . . . . . (Mexican)	63.32	1.80	26.68	6.64	1.56
Fuerte . . . . . (Hybrid)	60.86	1.25	29.14	7.40	1.35

The Collins, a Guatemalan variety which the writer has investigated, shows, along with the general characteristics, the following analysis:

<i>Moisture</i>	<i>Protein</i>	<i>Fat</i>	<i>Carbo- hydrates</i>	<i>Ash</i>	<i>Ref. Index*</i>
66	1.21	25.26	6.44	1.09	62.8 @ 250 C

Oil employed for lighting is pressed from the pulp; and from the seeds, which contain tannic acid, an indelible black ink used for marking linen is obtained.

In this country the avocado is commonly used in the form of a salad, usually combined with lettuce, onions and other vegetables. Experiments in extracting a table or cooking oil have been encouraging, but as yet the production of avocados in this country is not great enough to warrant commercial development. In the tropics, the fruit is added to soups at the time of serving; mashed with onions and lemon juice to form the delectable guacamole of Cuba and Mexico; or eaten as a vegetable with only salt as a seasoning. In Brazil it is considered more as a dessert than as a foodstuff, and is made into a delicious ice cream.

To a certain extent, the avocado takes the place of meat in the dietary of the Central Americans. Four or five tortillas (corn cakes), an avocado, and a cup of coffee, is considered a good meal by the Indians of Guatemala.

And so it has been predicted that the culture of this fruit will some day become more important than the citric culture in Florida and California.

\*Index Kewensis.

\*Refractory Index of Fat on Butyro Refractometer.

## THE TANNIN OF WILD CHERRY BARK.\*

By Josiah C. and Bertha L. DeG. Peacock.

In 1834, Stephen Proctor published in *THE AMERICAN JOURNAL OF PHARMACY* the results of an investigation which he had made of the constituents of wild cherry bark. In this report, besides the presence of certain other substances, he inferred that this drug contains tannin and gallic acid.

His analysis appears to have been made the basis of nearly every later reference by the textbooks to the constituents of this bark. But the presence of gallic acid has not been mentioned by all, nor would it likely be credited without question by any who would consult the original article, for the inference was drawn contrary to the evidence afforded by an appropriate test—the iron salt he used gave a green color, not the blue one which gallic acid produces.

The astringency of wild cherry bark seems to have been attributed to "tannin," with little, if any, regard to possible presence of gallic acid.

The list of constituents given for the bark almost invariably includes "a bitter principle."

While agreed on the source of the astringency, there has been a division of opinion regarding the substance which gives the bitterness. This property has been ascribed, in part, at least, to amygdalin; or to a similar substance, but amorphous; or to an entirely different material. By some, the bitter principle has been considered to be the fluorescent principle.

Until the suggestion now made by the writers, no one has viewed the tannin as contributing bitterness as well as astringency; and only through isolation of the tannin could such conclusion well be reached.

Although Stephen Proctor pointed out that the tannin of wild cherry bark gave green color and precipitate with an iron salt, the books have used the word "tannin" without reference to this fact, nor have they by other qualification distinguished this tannin from that so well known to pharmacists; while those references which have given gallic acid as a constituent have offered opportunity, if not indeed inclined, to the drawing of the incorrect inference that

\*Read before the 1923 Meeting of the Pennsylvania Pharmaceutical Association.

the tannin of wild cherry bark is tannin from which gallic acid is derivable.

It would be better if such uses of the word were more restricted or defined, especially since the "United States Pharmacopœia" gives the term "tannin" as synonym of Acidum Tannicum or Gallotannic Acid, and qualifies this use by stating that tannic acid is "a tannin usually obtained from nutgalls." Employment of the words "a tannin" is suggested, when mentioning the presence in drugs of substances of this class, particularly when the composition or characteristics are not sufficiently known to enable a statement which will differentiate from gallotannic acid.

The tannin of wild cherry bark has been blamed for most, if not all, of the troublesomeness of the preparations of this drug. It has been customary to say that certain menstrua extract more or less of the tannin; the opinion in general being that the less tannin removed the better the taste and keeping qualities of the preparation. The color of the cold-water infusion has been thought to be darker or lighter as the amount of the tannin was more or less. The addition of glycerin to the water used for percolating the drug in the preparation of the syrup has been opposed by some, on the ground that this addition extracts more of the tannin, while others have insisted that only by this use of glycerin can a satisfactory product be had.

The tannin has been estimated by several investigators, who have employed different methods. Its amount is given as varying from 2.5 to 4.5 per cent. By some, it is stated to be most abundant in autumn, while others find that "in the spring when the bark is least valuable it is richest in the tannin." The U. S. P. IX defines wild cherry bark as "the stem-bark of *Prunus serotina* Ehrhart (*Prunus virginiana* Miller) (Fam. Rosaceæ), collected in autumn and carefully dried."

An estimation of the tannin in the ground bark used in this work was made by the hide-powder method. This determination, which is regarded as only approximate, showed 3.33 per cent. for the air-dry drug. Loss upon drying to constant weight amounted to 2.14 per cent., which, taken for the purpose as moisture, would indicate 3.4 per cent. of tannin in an absolutely dry sample.

A striking feature which was recognized in the application of this method of estimation was the fact that one-third of the total hot-water soluble matter taken from the bark was absorbed by hide.

It was found impracticable to make a complete extraction of the cold-water-soluble solids before evidence of change became noticeable in the liquid. Such relatively large representation of the soluble solids and the readily alterable nature of the tannin make very evident the potentialities of this constituent for trouble in attempts to make and preserve uniform preparations of this long-used drug.

Our intention in undertaking this work was to extract and purify the tannin in order to learn something of it as an isolated substance. To obtain the tannin, a quantity of ground wild cherry bark was moistened with cold (but not distilled) water, macerated for twenty-four hours, and percolated with same solvent until the liquid coming through was pale yellow. The percolate was concentrated by evaporation until a dark wine-red liquid resulted. This was allowed to cool, and was then freed by filtration from the insoluble matter which separated during concentration; this was composed very largely of phlobaphene, but there was present also a decided showing of microscopic octahedra of calcium oxalate (a substance long known as present in the bark). Aside from determining the phlobaphene nature of the bulk of the insoluble matter, no further attention was paid here to these substances.

The clear filtrate was shaken with acetic ether to remove the tannin; the solvent layer was collected and distilled under reduced pressure in order to get the tannin as a solid.

In the last-named effort, it was found that the presence of some accompanying substance was preventing the tannin from "puffing" into the porous or spongy condition usually assumed at the stage of the distillation when all but a little of the acetic ether has been driven off. Upon continued application of the water-bath heat to thoroughly dry the residue which had been obtained, white flakes of feathery crystals were observed to be accumulating on the cork and in the delivery tube. Their behavior and form was so immediately suggestive of benzoic acid that for the moment our attention was diverted to a review of the circumstances which would permit benzoic acid to be present. Until this interference, we were unacquainted with the occurrence of benzoic acid in wild cherry bark. But, in 1909, Power and Moore reported finding benzoic acid and a number of other substances not previously known to exist in this drug. (See *Jour. Chem. Society [English]* [95], 1909, page 243; or abstract in *Proc. Amer. Pharm. Assoc.*, 1910, page 208.)

Our reflection ran as follows: Why might not benzoic acid be present here, since it results from oxidation of benzaldehyde, and this tendency of benzaldehyde is a constant proclivity? Benzaldehyde was present in the original percolate, but, if judged by odor, not in the concentrated liquid shaken with acetic ether. Perhaps it has been oxidized to benzoic acid, but here is evidence of a much larger amount of the acid than that source and change could supply even if all of it were oxidized, which is unlikely, because a portion would have been volatilized unchanged from the liquid as this became warm. From where, then, does this amount of it come? The simultaneous production of benzaldehyde and hydrocyanic acid when the bark is moistened with water is well proven. There has been widely quoted the statement that the dry bark of commerce does not contain either hydrocyanic acid or benzaldehyde, and an examination of the dry bark, without moistening, strengthens this impression. However, Stevens while collecting the bark found it to have an odor of bitter almond. In this instance, the odor would scarcely be attributed entirely to hydrocyanic acid, but rather to both it and benzaldehyde as the products of the well-known reaction which takes place when the dry bark is moistened; for is not the bark on the tree functioning under the influence of its life moisture, its sap? The removal of the bark interrupts the plant process by discontinuing the moist condition essential to it. The loss of the odor of bitter almond when the fresh bark is dried must be due to volatilization of the hydrocyanic acid and benzaldehyde, or to alteration into something which differs in odor. The extremely volatile hydrocyanic acid may well be regarded as dissipated with little or no change, but the less volatile benzaldehyde would be inclined to undergo more or less oxidation to benzoic acid, besides in part passing off unchanged. And, is it not likely that this change is in constant operation in the living bark, with production and accumulation of benzoic acid therein? As regards the detached bark, the contained benzaldehyde, perhaps dries off in part, but because its comparatively minute quantity is through relatively wide distribution so effectively given surface exposure, it is quite as likely oxidized *in situ* to benzoic acid. This conception appears as highly probable, indeed. Again, when the dried bark is chewed, or otherwise moistened, with cold water, does not the bark merely resume (to the extent possible with the now limited supply of the essential materials) the production of the substances which gave the living bark its odor of bitter almond? Therefore, would not the bark



when collected probably contain benzoic acid, and would not the amount of this be increased by permitting the interrupted process of its production to resume by restoring the moisture necessary to this function? These crystals might well indeed be benzoic acid.

And subsequent examination showed them to be benzoic acid.

The foregoing thought leads also to recognition of the probability that benzoic acid may well be expected to be found in every plant substance wherein benzaldehyde has existed—the scope of which suggestion points to many possibilities of its occurrence.

In further examination of the thought that the greater part of the benzoic acid must exist in the bark prior to concentration of the percolate, it was recalled that considerable needles of benzoic acid had been observed to separate when some of the final portions of the water percolate, which had come through with but little color, had been boiled down. Their appearance was made long after the odor of the percolating liquid had ceased to suggest the presence of benzaldehyde. But, to learn of the possible influence of the heat used for evaporation of the percolate as a factor in the production of benzoic acid, another lot of the ground bark was macerated and percolated with cold water. The percolate was not concentrated, but at once shaken with acetic ether. The amount of benzoic acid which was encountered in this process was apparently as great as that in the case of the concentrated percolate. It thus became more evident that the bulk of the benzoic acid exists in the bark before the moistening process.

Finally, the existence of free benzoic acid in the bark was proven by direct extraction with ether and with chloroform; removal of solvent; treatment of extracted matter with water; shaking of aqueous solutions with ether and with chloroform, and separation and evaporation of these solvents.

Returning to the process of extraction of the tannin from the concentrated percolate, the residue left upon evaporation of the acetic ether was, at first, resin-like in appearance, nearly transparent; but, when it had become cold, was found to be largely composed of needle-shaped crystals. Each successive shaking of the concentrated percolate with acetic ether gave a similar mass; and these residues gradually showed an increasing proportion of the crystals. These residues were stirred with cold ether for the purpose of removing from the tannin such substances as would be dissolved. The greater part of the benzoic acid entered solution. Along with it, the ether dissolved an appreciable amount of a plastic, red ma-

terial. When warm, this substance seemed to mix with the benzoic acid in such way as to obscure its crystals; but when cold, the needles became plainly visible throughout the plastic, resin-like material. Boiled with water, this mass gave up benzoic acid, which readily crystallized from solution upon cooling; but not without the red portion entering solution to a considerable extent, for concentration of the reddish liquid so obtained resulted in the settling out of a dark-red substance, which, when cold, varied in consistency from fluid to semi-solid.

Both the hot- and cold-water solutions of the ether-dissolved substances displayed decided fluorescence. No further work was done on the last-named materials.

Under treatment with cold ether, the residue containing the tannin took at first the form of a granular, red, porous powder; but with accumulation of moisture, through constant condensation brought about by the cold resulting from evaporation of the ether, the undissolved matter became plastic. To relieve this situation, the residue was redissolved in acetic ether, and re-obtained by distilling off the solvent *in vacuo*. This material was then stirred with cold chloroform; to appearances, it removed a trifle of yellow color. Upon recovery, the chloroform left an oily-looking liquid. When this liquid was boiled with water, it separated into much benzoic acid and a small amount of oily drops. The solutions so obtained showed much fluorescence. Beyond identifying the benzoic acid, nothing was undertaken with these materials.

When the now partly purified tannin had dried free from chloroform, it was found to be a finely divided, reddish-yellow powder. This powder was treated with water, which left a considerable undissolved portion. The aqueous solution was clarified by means of paper pulp and filtered. The clear reddish-amber solution was shaken with acetic ether, its layer separated and the solvent removed by distillation *in vacuo*. The residues thus had were subjected to separate, successive treatments with ether and chloroform as outlined; after which, the tannin was again dissolved in water, and the whole process of purification repeated over and over, until the ether and chloroform failed to remove appreciable matter.

Judging by the bulk of benzoic acid which separated as this work was carried on, it is felt that there may be quite as much of free benzoic acid in wild cherry bark as there is of the tannin. Though now but speculation, the possible presence of benzoates also is a matter for investigation.

The many repetitions of the foregoing process of purification finally gave the tannin in straw-yellow or faintly pinkish, porous masses, with satiny lustre or highly iridescent effect; these spongy masses were readily reducible to powder. The variations in color depended upon the extent of alteration which had occurred when the acetic ether solution was evaporated *in vacuo* to obtain the tannin in solid form. Snow-white porous masses which at first formed in the distilling flask, when the solution in acetic ether had reached a degree of concentration where solid showed above and about the boiling liquid, are believed to indicate the true color of this tannin; but, while the vaporization of the last portion of the solvent was being effected, the color of these masses changed to straw-yellow or faintly pinkish, it is thought because of slight decomposition of the solvent with production of acetic acid, which is now known to exert an altering effect on the tannin. And it does not seem improbable that traces of benzoic acid, still adhering, caused or increased this behavior of the acetic ether, or this effect upon the tannin. It was not found to be practicable to disconnect the flask and remove the white masses, for immediate condensation of the acetic ether vapor caused their instant disappearance through solution. Nor, did there seem to be any other way of overcoming this objectionable action, which invariably rendered part of the tannin insoluble in cold water.

The tannin of wild cherry bark extracted and purified by the given method is a bitter as well as astringent substance. It was readily and completely soluble in hot water; when treated with cold water, a quantity entered solution at once, imparting an amber color, while a greater amount remained undissolved as a peculiar, plastic phlobaphene. The 1 per cent. solution made with hot water had an amber color. Solutions of the tannin in hot water, when allowed to cool, acquired yellowish turbidities. Both hot- and cold-water solutions gave white precipitates with gelatin. When cold, the solutions of the tannin gave dark-green colors and precipitates with ferric chloride and ferric acetate, the green shades becoming blackish on standing, or upon use of excess of reagents. Lead acetate caused a canary-yellow precipitate in the solutions. The solutions of the tannin, like the substance itself, had both bitter and astringent tastes, which were appreciable in this order of effect; the bitterness was experienced first; it persisted, almost to the exclusion of the astringency, which was felt only after the bitterness had passed;

recurrences of the taste seemed to be entirely those of bitterness. Blue litmus paper was intensely reddened by the solutions. The amber colors of the solutions were destroyed by addition of either diluted sulphuric, oxalic or benzoic acid; no fluorescence was manifested thereupon. When portions of solution acidified with these acids were heated in a boiling water-bath, reddish colors developed, and later red substances were deposited. As control, an unacidified portion of the tannin solution showed only the slightest reddening. This, or a similar change, was found to take place with benzoic acid even in cold dilute solutions, upon a few days' standing. This effect of benzoic acid on the tannin is noteworthy by those concerned with the preparations of wild cherry bark.

Six per cent. acetic acid at first behaved toward the tannin like cold water, but soon dissolved the substance entirely. Furthermore, the insoluble substance produced by contact with water was found to be at once dissolved by 6 per cent. acetic acid. When solutions made with acetic acid were heated on a water-bath, no precipitation took place, but their amber colors were reddened. Both weak and strong acetic acids dissolved the red substances referred to above as produced by the action of diluted sulphuric, oxalic or benzoic acid. The tannin was at once freely soluble in 36 per cent. acetic acid with formation of amber-colored solution; dilution of this fluid, or of any other containing acetic acid, with water did not cause precipitation. The tannin was readily soluble in alcohol, weak or strong; insoluble in ether free from alcohol, otherwise soluble; insoluble in chloroform or benzol. The tannin was freely soluble in glycerin, as were also both water-produced and acid-produced insoluble red phlobaphenes; these glycerin solutions remained brilliant upon dilution with water.

When the tannin had been found to be bitter as well as astringent, attention turned to the question: Whether this constituent contributes all or but part of the bitterness of the drug? In an effort to get information on this matter, infusions of the bark (some representing as much as 30 per cent. of the drug) were treated with well-washed hide-powder. The following facts were noted: Before maceration with hide, the freshly prepared infusions (light wine-red or reddish-amber in color, when viewed in half-litre flasks) were immediately and decidedly acid to litmus paper; pronouncedly bitter and astringent as already described. After maceration with two successive treatments of hide-powder, these liquids, except for

the distinct blue fluorescence, were almost entirely free from color; the odor was changed, but not removed; acidity to litmus paper was shown only upon standing; neither bitterness nor astringency could be detected; ferric chloride gave but the slightest greenish tinge that could have been discerned; there was no precipitate with either gelatin or lead acetate solution.

These treatments with hide-powder were made on infusions prepared with both hot and cold water, but the hot liquids were allowed to cool before being brought into contact with the hide. The results were uniform when the infusions were used without delay; but not so, when old infusions were treated. A single treatment with hide-powder did not appear to effect complete removal of the tannin within a period not likely to admit of the variance just referred to as attendant upon delay. The several steps in the treatments with hide-powder were controlled by using an equal amount of this material with water alone. All detannated liquids were filtered before results were noted.

Some of the filtered, clear, fluorescent liquid from the hide treatment was shaken with chloroform; the layer of the latter separated, and the solvent evaporated. A small amount of white crystalline residue was obtained. This was but sparingly soluble in water; the solution displayed blue fluorescence. Upon the addition of ammonium hydrate, to alkalinity, a very high degree of fluorescence resulted. Appearances, however, pointed to the probability that the greater part of the crystalline residue was benzoic acid. The natural fluorescence in the infusions of the bark, or other solutions which exhibit it, should not be confused with like phenomena artificially brought about with outside agents, such as alkalis.

Because of the presence of so much calcium oxalate in the concentrated percolate, an effort was made to learn if free oxalic acid was present in the bark. To avoid any opportunity for it to combine with calcium or other bases, distilled water was used to percolate the bark. After concentration, the liquid was detannated by maceration with well-washed hide-powder, filtered, then made alkaline with ammonium hydrate, again filtered, then acidified with hydrochloric acid, again made alkaline with ammonium hydrate, acidified now with acetic acid, and tested with calcium acetate solution. There was no precipitation by the calcium compound at this point to indicate the presence of oxalates; but that the conditions

were favorable to their detection was proven by a control test, which, besides other matters, took into consideration the presence of free benzoic acid in the solution. The result of the experiment would seem to indicate that uncombined oxalic acid is not present in the bark.

As ferric chloride caused no blue color in the infusion after the latter had been detannated, the absence of gallic acid is regarded as now proven, especially since the addition of a minute amount of this substance, by giving the characteristic blue color, showed that conditions were favorable to its detection. Gallic acid should, therefore, be omitted from the list of constituents of wild cherry bark.

That the fluorescence of the infusion was not removed by hide-powder while the astringency and bitterness were completely absorbed are facts clearly established by that treatment; and, since fluorescence remained in the fluid from which all bitterness and astringency had been removed, it seems proper to regard the sources of these properties as different. Again, since the purified tannin was bitter as well as astringent, and no bitterness or astringency remained in the fluid from which all tannin had been absorbed (as proven by means of ferric chloride, gelatin and lead acetate), the conclusion that the tannin furnishes all of the bitterness and astringency seems justified. And if, in the light of the determined characters of the tannin of wild cherry bark, we review the descriptions of efforts which have been made to isolate "a bitter principle," and compare the comments on the observed nature of the substance sought, there seems to be every reason to believe that, because of the inherence of bitterness in the tannin, it has all of the qualifications needed to elude isolation by the methods which have been employed to find another substance representative of this property of the drug.

The tannin of wild cherry bark having been found to be bitter, there arose the question: Is it the bitter tannin found in red and pale rose petals—the drugs coming from the same natural order of plants? The answer is in the negative, for the tannin of wild cherry bark does not yield the peculiar burr-like aggregates characteristic of the rose tannin when its solution is boiled with acids.

The results of this work may be summarized as follows:

Gallic acid is not present in wild cherry bark.



Cold water extracts but part of the tannin; for there is also a considerable proportion of cold-water-insoluble phlobaphene.

The tannin of this bark, as pointed out by Stephen Proctor, is an "iron-greening" tannin.

This tannin yields a red phlobaphene by action of acids, including that of benzoic acid.

There is a considerable proportion of free benzoic acid in this bark, the occurrence of which was first reported by Power and Moore.

The occurrence of benzaldehyde in living plant material may well be taken as indication of possible presence of benzoic acid in any subsequently dried form of the part.

The tannin is the bitter principle as well as the astringent constituent.

The bitter principle, which is the tannin, is not the fluorescent principle.

It permits of better understanding of the troublesomeness of the preparations of wild cherry bark to know that the free benzoic acid contained in the drug decomposes the cold-water-soluble tannin with production of cloudiness or sediment; and, because of this action, the blame which, in the past, has been placed entirely upon the tannin, may now be equally accorded to the benzoic acid.

The addition of glycerin to the water used for extraction of the bark in the preparation of the syrup will now be fully appreciated as warranted by the association in the bark of the tannin and benzoic acid, as well as by the teaching of experience with its use.

Also, due allowance must be made for variation in the products of those vegetable drugs which bring into the course of preparation the resumption of an interrupted plant process. For this reason, variation in the preparations of wild cherry bark must be expected, even though glycerin or acetic acid (both solvents for the decomposition products of the tannin by the benzoic acid), or both, be employed in the menstruum.

**IRON AND IRON ALLOYS.****By Frank X. Moerk, Ph. M.****Professor of Analytical Chemistry, Philadelphia College of  
Pharmacy and Science.**

(Continued from July Issue.)

**Constituents of Steel and Cast Iron.**

Ferrite and cementite are distinguished according to their source:

Pro-eutectoid ferrite separating along the line G-O-S found in 7 and 8A.

Pearlitic ferrite, constituent of pearlite, found in 8A and 8B.

Pearlitic cementite, constituent of pearlite, found in 8A and 8B.

Pro-eutectoid cementite separating along the line S-E, found in 5.

Eutectic cementite separating along the line B-D, found in 5.

Primary cementite separating along the line B-C, found in 3.

Graphite, found as a rule only in "mottled" and "gray" cast iron.

*Ferrite*.—Free alpha-iron, nearly pure; may contain a little phosphorus and silicon, and at the most 0.05 per cent. and perhaps never as much as 0.02 per cent. carbon. In addition to the sources already given, it may be formed by the decomposition of pearlite in low-carbon steels, of cementite under abnormal conditions, and may be found uncoagulated in sorbite and probably in troostite. Hardness 3.5-3.7, therefore soft, relatively weak, very ductile, strongly magnetic; has tensile strength, 40,000 pounds per square inch.

*Pearlite*.—The iron-carbon eutectoid consisting of alternate masses of ferrite and cementite, is a conglomerate of about 6 parts ferrite and 1 part cementite, containing 0.9 per cent. carbon and 99.1 per cent. iron; one of the final products in the transformation of austenite. Under high magnification, both ferrite and cementite are revealed.

*Cementite*.—Ferric carbide  $\text{Fe}_3\text{C}$ . (Manganese and other metals may replace the iron forming tricarbides, called "manganiferous

\*One of a Series of Popular Lectures, delivered at the Philadelphia College of Pharmacy and Science, 1922-23.

cementite," etc.) In addition to the previously given sources of cementite it also occurs uncoagulated in sorbite, troostite and possibly martensite; as spheroidized cementite in steels quenched from high temperatures. During annealing may break up into graphite and austenite above  $A_1$  or into graphite and ferrite below  $A_1$ ; the graphitizing tendency is completely checked in the cold, but increases with the temperature and with the proportion of carbon and silicon present and is opposed by the presence of manganese and chromium.

It is the hardest component of steel, having a hardness of 6, scratches glass and feldspar, but not quartz, and is very brittle.

*Graphite.*—Probably pure carbon, identical with natural graphite, derived wholly or in large part from cementite; forming small, black, rounded particles surrounded by ferrite, in annealing may separate from cementite and austenite. Very soft, hardness 1-2; flexible; soils paper; greasy to the touch. After polishing, graphite appears as black areas, under the microscope.

The important constituents looked for in the microscopic examination of prepared surfaces (metallography) include in addition to those mentioned some transition products and also some inclusions due to impurities.

*Austenite* (sometimes wrongly called martensite) is a solid solution of carbon (or iron carbide) and gamma-iron and may have any carbon content up to saturation, 0.9 per cent. at S ( $725^\circ$  C.) to 1.7 per cent. at E ( $1130^\circ$  C.). Very ductile and slightly magnetic.

It is normal and in equilibrium in 4, associated with gamma-iron in 6, with alpha-iron in 7, and with cementite in 5. In cooling slowly through  $A_{3.2.1}$  austenite shifts its carbon content spontaneously through generating ferrite or cementite to the eutectoid ratio, 0.9 per cent., and then transforms with increase of volume into pearlite, with which the ejected ferrite or cementite remains mixed.

Rapid cooling and the presence of carbon, manganese and nickel obstruct this transformation; hence, by combining these four obstructing agents in proper proportions, the transformation may be arrested at any of the intermediate stages (martensite, troostite or sorbite) and, if arrested in an earlier stage, it can be brought to any later desired stage by a regulated reheating or "tempering."

A rapid cooling in the absence of these obstructing elements

checks the transformation but little and only temporarily, yet if aided by the presence of a little carbon the transformation is wholly arrested in the martensite stage; in the presence of 1.4 per cent. carbon rapid cooling retains about one-half the austenite so little altered that it is considerably softer than the usually dark needles of the surrounding martensite, with which it sharply contrasts.

About 1 per cent. carbon with 12 per cent. manganese, or about 25 per cent. nickel lowers and obstructs the transformation to such a degree that austenite persists, apparently unaltered, even through a slow cooling.

Austenite is never associated with ferrite and pearlite.

*Martensite.*—The early stage in the transformation of austenite, characterized by needle-like structure and a hardness which is greater than that of any other constituent of the same carbon content; the hardness and brittleness increase with the carbon content up to 0.9 per cent. It is magnetic and is the chief constituent of hardened carbon tool steels and of medium nickel and manganese steels. It represents a meta-stable condition in which the metal is caught during rapid cooling in transit between the austenite condition, stable above  $A_1$ , and the condition of ferrite plus cementite into which the steel habitually passes on cooling slowly past  $A_1$ .

In 1.5 per cent. carbon steel, rapidly quenched, it is associated with austenite; in more fully transformed steels (low-carbon steels, hardened; high-carbon steels, oil hardened, or water hardened and slightly tempered; or hardened thick pieces even of high-carbon steel) it is associated with troostite and with some pro-eutectoid ferrite (in hypo-eutectoid steels) or pro-eutectoid cementite (in hyper-eutectoid steels).

In tempering it first changes successively into troostite, osmondite, sorbite and at about  $700^{\circ}$  C. into granular pearlite, which, on heating into the transformation range, changes into austenite, and this on cooling yields lamellar pearlite. Characteristic specimens are obtained by heating bars, 1 cm. square, of eutectoid steel (0.9 per cent. carbon to  $800^{\circ}$  C. and quenching in cold water.

*Troostite.*—An uncoagulated conglomerate of the transition stages following martensite, with which it is habitually associated; carbon content varies considerably. May arise either on reheating hardened (martensitic) steel to slightly below  $400^{\circ}$  C., or by cooling under proper conditions through the transition range; higher reheating will form sorbite, then pearlite.

*Osmondite*.—That stage in the transformation of austenite at which the solubility in dilute sulphuric acid reaches its maximum rapidity; arbitrarily taken as the boundary between troostite and sorbite. Hardened 1 per cent. carbon steel reheated to 350-400° C. passes through the stage of troostite to that of osmondite and on higher heating to that of sorbite. Conditions to bring hardened steels of other carbon content to the osmondite stage are not known.

*Sorbite*.—An ill-defined, almost amorphous, conglomerate of irresoluble pearlite with ferrite (in hypo-eutectoid steels) or cementite (in hyper-eutectoid steels), lighter in color and softer than troostite for the same carbon content; usually associated with pearlite, but differing from this in that the individual constituents are not revealed under high magnification (irresoluble). Formed (1) by reheating hardened steel to a little over 400° C., but not to 700° C., at which latter temperature it coagulates into granular pearlite; (2) by quenching small pieces of steel in oil or molten lead, or even by air-cooling them; (3) by quenching in water from just above the bottom of the transition range  $A_1$ . Sorbite remains unchanged below 400° C.

It is slightly less ductile than pearlitic steel for given carbon content, but its tenacity and elastic limit are so high that a higher combination of these three properties can be had in a sorbitic steel than is possible in a pearlitic steel of somewhat higher carbon content; hence the use of sorbitic steel for structural purposes needing the best quality.

*Inclusions*.—These represent impurities present in iron-carbon alloys which are insoluble in these alloys at ordinary temperatures, and may be seen by microscopical examination before etching; they consist of the oxides, sulphides and silicates of iron and manganese and phosphides of iron, and represent either entrained slag or segregations which in good metal should be present in but small quantity and evenly distributed. A few other inclusions are due to additions made to produce better iron and steel.

Aluminum, because of its powerful deoxidizing property, is added to steel to prevent the retention of gas bubbles or blowholes; the gas may be entangled air or carbon monoxide produced from the carbon of the metal and atmospheric oxygen. Aluminum oxide is difficultly fusible and therefore hard to remove.

Titanium, added to iron and steel, has the property of removing the last traces of dissolved oxygen and nitrogen, as well as increasing the fluidity of entangled oxides and slag in steel castings and ingots, which enables their more ready separation from the metal. Titanium nitride may be found under the microscope.

Zirconium rapidly removes oxygen and nitrogen, and the last traces of ferrous sulphide difficultly removable by manganese; zirconium nitride appears as small, yellow cubical crystals under a magnification of 500 diameters.

### Microscopical Examination.

Emery, corundum and alundum (composition  $\text{Al}_2\text{O}_3$ ); crystalon and carborundum (composition  $\text{SiC}$ ) are the abrasives used for grinding small sections, about one-half inch square, of the specimens to be examined; coarser grades are used at first, followed by finer grades until the final surface is perfectly polished and free from scratches.

The examination is made, as for all opaque objects, by reflected light, and should be conducted in three stages: After receiving as perfect a polish as possible, it should be examined to determine the quantity, distribution and nature of the slag; then it should be lightly etched to reveal the quantity and condition of the carbide occurring as pearlite, cementite, sorbite, *etc.*; finally, it should be deeply etched to show the crystalline structure.

Usually a magnification of 200 diameters is common, but sometimes as low as 50 and occasionally as high as 500 and even 1000 diameters are used.

Inclusions, slag, may be of various colors, as gray, black, fawn, brown and sometimes blue; under high magnification, masses may reveal individual constituents:

Manganese sulphide: Pale dove or slate-gray masses; rounded in castings; ductile therefore in rolled metal or forgings appears elongated; with acid etchants liberates  $\text{H}_2\text{S}$  and the surface becomes pitted (distinction from silicate).

Ferrous sulphide: Yellow or pale brown in color; brittle; with acid etchants responds like  $\text{MnS}$ .

Iron phosphide: Whiter than the surrounding metal; blackens with sodium picrate.

Manganese silicate: Darker than the sulphide.

Ferrous silicate: Dark.



Aluminum oxide: Most difficultly fusible inclusion.

Titanium nitride: Pink crystals.

Tests for sulphides and phosphides: (1) The polished surface is covered with silk impregnated with an acidified mercuric chloride solution; local darkening indicates the sulphide areas; phosphides produce lemon-yellow mercuric phosphide. (2) The polished surface is covered with silver bromide paper moistened with 3 per cent. sulphuric acid; the sulphide and phosphide areas are shown by the formation of black sulphide and phosphide of silver. Phosphides do not respond as quickly as sulphides in these tests.

Before stating the composition and action of the etchants, the structure of the iron and steel constituents under the microscope should be given:

Ferrite: Parallel plates; polygons; network; irregular figures; component cubes.

Pearlite: Conglomerate of ferrite and cementite; granular; lamellated.

Cementite: Plates; network; spheroids.

Graphite: Flaky plates; small black particles.

Austenite, generally with martensite: White irregular crystals.

Martensite: Zig-zag shapes; needle structure; plates composed of needles.

Troostite: Irregular; finely granular; almost amorphous.

Osmondite: Ill-defined.

Sorbite: Ill-defined; almost amorphous.

The last three constituents are not resolved even under the highest magnification.

### Etchants.

*Licorice Extract.*—This was one of the first reagents giving beautiful results, but soon replaced by more rapid etchants. The specimen to be etched was rubbed vigorously upon a smooth piece of parchment, moistened with an aqueous extract of licorice, and upon which some precipitated calcium sulphate had been placed to act as a polishing powder; rubbing was continued until the structure appeared.

*Ammonium Nitrate* (2 per cent. solution).—This reagent, replacing the aqueous licorice extract, was found to give the same results.

Ferrite distinguished by the crystalline structure;

Pearlite by the unequal etching of its constituents;  
Cementite and austenite are unaffected;  
Martensite by the needle structure;  
Troostite by the yellow, brown or blue bands merging into each other;  
Sorbite by the yellow to dark-brown color.

*Manipulation With Other Etchants.*—With the exception of sodium picrate, the polished specimens, freed from grease by alcohol or by rubbing with the finest emery paper, are either placed in a shallow dish, covered with the reagent and rocked to keep the reagent of even strength and to dislodge gas bubbles; or else the reagent is applied by means of a brush. The operation is continued until the surface is sufficiently acted upon and then the reagent is displaced by washing with alcohol or water; in the latter case the water is removed, and drying facilitated, by using several portions of alcohol and, finally, ether.

In the case of sodium picrate, the specimens are placed in a casserole, covered with the reagent, boiled for ten minutes, then washed and dried.

Many of the etchants, in addition to developing the characteristic structures, color some of the steel constituents, which makes their recognition easier and in fact gives the means for identifying troostite, osmondite and sorbite.

Hydrochloric acid, 1 cc. (sp. gr. 1.19) to 100 cc. alcohol; unstable.

Nitric acid, 4 cc. (sp. gr. 1.42) to 100 cc. alcohol; unstable.

Picric acid, 4-5 gm. in 100 cc. alcohol.

Benedick's reagent, 4 gm. meta-nitrobenzoic acid in 100 cc. alcohol.

Iodine solution, 10 gm. iodine and 20 gm. potassium iodide in 100 cc. water.

The above reagents have practically the same action; the inorganic acids and iodine are of course the most active; ferrite and cementite do not develop color; pearlite apparently darkens, due to an effect of shadow and relief; austenite and martensite develop slowly, while troostite, osmondite and sorbite develop color rapidly. Austenite is sometimes developed by using a saturated solution of picric acid in alcohol. Graphite and manganous sulphide are revealed as dark spots in white ferrite by picric acid.

Kourbatoff's reagent: (a) 5 cc. nitric acid (sp. gr. 1.20) added to 95 cc. glacial acetic acid; (b) a mixture of equal volumes of methyl, ethyl and amyl alcohols. For use mix one volume of (a) with three volumes of (b). Used to distinguish troostite from all other steel constituents; after seven minutes immersion only troostite will be colored.

Sulphurous acid: 4 per cent. in water or alcohol solution. Colors due to austenite, martensite and troostite can be distinguished. As cementite is not colored, this reagent has been used to show cementite in troostite.

Sodium picrate: 2 gm. picric acid and 8 gm. sodium hydroxide in 100 cc. water. Only cementite and iron phosphide are blackened, the former rapidly, the latter but slowly.

Heyn's reagent: 12 per cent. cupric-ammonium chloride in water; after immersion the deposited copper is removed with 10 per cent. nitric acid. Used to show the macrographic structure of steels and to show the component cubes in ferrite.

Ferric chloride dissolved to saturation in dilute sulphuric acid will readily etch stainless steel.

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Spark pictures have recently been suggested as a means of distinguishing steels of various carbon content and also of steel-alloys. The specimens, best in form of rods or bars, are pressed firmly against the rapidly revolving emery wheel; the path of the spark from its origin to its extinction forms a line of light which, at the end, branches out in every direction, having an explosion-like appearance and resembling branches of blossoms. The number of lines making up the ray, the color, and the blossom-like appearance show considerable variation, depending upon the composition of the steel.

### **Metals and Ferro-Alloys.**

Metals and ferro-alloys used in the manufacture of various kinds of steel; generally added to the molten steel in the crucible or in the ladle:

Aluminum or ferro-aluminum, 5-20 per cent. Al; used as a deoxidizer.

Ferro-boron, 10 per cent. B; used for boron-steel, 0.5 per cent. B and 0.22 per cent. C, having high tensile strength and great resistance to shock.

Cobalt, one of the metals imparting red-hardness to steel; used in high-speed steel.

Ferro-cerium, 30-35 per cent. Ce, readily sparks with moderate friction, used in gas lighters; disintegrates after a time.

Ferro-chrome varies in composition as made by different processes: Crucible, 19.8 per cent. Cr and 3.8 per cent. C; blast-furnace, 41.4 per cent. Cr and 7 per cent. C; electric furnace, 63.5-64.5 per cent. Cr and 1-10 per cent. C; low-carbon ferro-chrome, 70 per cent. Cr and 0.5 per cent. C. Imparts great hardness; resistant to shock and corrosion; used for making chrome-steel.

Copper, to the extent of about 0.3 per cent., gives a steel withstanding atmospheric corrosion and much more resistant to dilute acids.

Ferro-manganese, the most extensively used ferro-alloy in the steel industry, 80-85 per cent. Mn, 6.5 per cent. C, 1 per cent. Si, 0.25 per cent. P, 0.01 per cent. S; spiegel-eisen contains 15-20 per cent. Mn. Used in Bessemer and open-hearth steel manufacture as a deoxidizer and desulphurizer and for recarburization. Used for softening, strengthening and purifying hard or chilled iron; for toughening soft iron; for making manganese-steel.

Ferro-manganese-silicon: Made by melting ferro-manganese and ferro-silicon. Contains 20-35 per cent. Si, 50-75 per cent. Mn and 1-19 per cent. Fe, with low carbon content because of the high Si content. Used as a deoxidizer and for manganese-silicon-steel.

Ferro-molybdenum, 50-85 per cent. Mo, 11-49 per cent. Fe and 0.35-0.4 per cent. C; used because, even in small quantities, it increases resistance to blows and because it imparts red-hardness to steel in high-speed steels. Tungsten can be replaced in alloys by one-half the quantity of molybdenum.

Nickel or ferro-nickel, 25-85 per cent. Ni; imparts toughness and resists the development of fatigue; present in certain proportions allows expansion to be regulated. Used for nickel-steels.

Ferro-phosphorus, 16-25 per cent. P; used in steel for tin plate, enabling more satisfactory rolling and coating.

Ferro-silicon, the most extensively used of all electric-furnace alloys. With Si up to 30 per cent. the alloy is hard, with no tendency to disintegrate; between 30 and 65 per cent. the alloy crumbles and falls to powder, usually accompanied by an offensive and poisonous gas (due to As, P, Si?); above 70 per cent. the alloy is brittle but will not disintegrate. Used as a deoxidizer, to prevent

blowholes, for precipitating C, thus softening cast iron (with 7 per cent. Si only graphitic carbon can be present); used for making silicon-steel.

Ferro-titanium, 10-25 per cent. Ti, 1-8 per cent. C, and 0.35-1 per cent. Si; used as a deoxidizer or scavenger for occluded oxygen and nitrogen and produces a superior surface for galvanizing and tinning; used for titanium-steel, for cutting tools, giving these greater ductility; for increasing the crushing strength of cast iron (as much as 50 per cent.).

Ferro-tungsten, 50-80 per cent. W and 0.5-4 per cent. C; used for tungsten-steel, in self-hardening, and because it imparts red-hardness in high-speed steels.

Ferro-uranium, 30-50 per cent. U and 1.5-4 per cent. C; used for high-speed steel with V, Cr and W or Mo.

Ferro-vanadium, 30-40 per cent. V and 0.1-0.4 per cent. C; used as a deoxidizer, also to impart great strength and hardness to steel and to make it more resistant to jar.

Ferro-zirconium, 10 per cent. Zr. Silicon-zirconium, 45 per cent. Si, 35 per cent. Zr. Zirconium combines energetically with oxygen and readily forms nitrides, sulphides and carbides; 0.05-0.1 per cent. Zr sufficient as a deoxidizer and scavenger; 0.15 per cent. Zr will also fix the nitrogen and 0.22 per cent. Zr will break up the last traces of FeS (a task not readily performed by Mn). Steel, with as much as 0.19-0.22 per cent. S, after addition of Zr can be readily rolled.

### Classification of Steels.

Steels are classified according to their carbon content into:

Eutectoid, 0.9 per cent. C, with pearlite as the constituent after normal cooling; in absence of other metals this gives the strongest carbon steel.

Hypo-eutectoid, less than 0.9 per cent. C, with ferrite and pearlite as the constituents after normal cooling; this class includes wrought iron, soft steel, machine steels, structural steel, railroad rails, and even a great majority of spring steels.

Hyper-eutectoid, between 0.9 and 1.7 per cent. C, with pearlite and cementite as the constituents after normal cooling; this class includes chiefly the steels used for cutting tools.

Case-hardened steels: Low-carbon steels, 0.15-0.25 per cent. C, will not harden appreciably by quenching, but will take up car-

bon if heated with some material containing carbon, as charcoal, charred leather, powdered bone, or with some carbonaceous gas like CO or CO<sub>2</sub> (to use the latter, the steel packed in charcoal should be heated to 800-1000° C. before passing in the gas). The penetration of the carbon should not exceed 1.5 mm. (0.06 inch); the carbon on the surface may vary between 0.85 and 1.1 per cent., depending upon the use to be made of the steel; deeper penetration and excessive carbon will produce brittleness, thus defeating the object of case-hardening. Finally the steel is quenched. Case-hardened steels are used for gears and wearing and cutting parts.

Heat-treated steels, 0.2 per cent. or more C, are described as pearlitic, sorbitic, martensitic, austenitic, *etc.*, depending upon the constituents produced. The steels are heated into the transformation range above A<sub>3</sub> (917° C.), maintaining the temperature for some time so that the equilibrium can be established, then quenching by immersion in water, oil or sometimes molten lead; this treatment is followed if desired by annealing in which the metal is reheated to certain specified temperatures below 725° C. and allowing to cool slowly. In some cases to produce proper results the metal is heat-treated a second and even a third time; the first treatment at the highest, the second at a somewhat lower and the third at a still lower temperature.

Quenched steels, suddenly cooled from high temperatures, are the hardest and most brittle (manganese steel an exception).

Annealed steels, slowly cooled after quenching and reheating to definite temperatures, are softest and toughest.

Tempered steels, suddenly cooled after quenching, reheating to moderate temperatures and again quenched, are intermediate in properties.

Ternary alloys or special steels contain, besides Fe and C and the small amount of Mn, another metal which imparts valuable properties to the alloy. The metals found most useful are Cr, Mn, Ni, Ti, V for structural steels, and Co, Mo, W, U for high-speed steels (Cr and V are also used in this class).

Quarternary alloys contain two or more of these metals.

Self-hardening steels, as the name implies, require no quenching, result upon normal cooling or by aid of an air blast; they contain Ni, W, Mo, Mn or a mixture of Cr and Mn.



High-speed steels, used for cutting tools, containing W or Mo or a mixture of Co and Cr, are effective even though by friction the steel becomes heated to dull-redness, therefore are said to possess the property of "red-hardness"; an important discovery which increased the durability of high-speed steels was a method of heat treatment. Tungsten high-speed steel, 0.4-0.9 per cent. C, heated to 1200-1260° C., rapidly cooled to 843° C. in a bath of molten red-hot lead kept below this temperature, and then either rapidly or slowly cooled to atmospheric temperature; it is then reheated in a lead bath to 371-671° C. and again cooled, rapidly or slowly, to atmospheric temperature. Molybdenum or cobalt high-speed steels are heat-treated as above, but the maximum temperature is 982° C.

The remarkable properties in the last two classes of steels depend upon retarding or preventing the change of austenite into pearlite. Under austenite the action of carbon, manganese and nickel was mentioned. Chromium, like carbon, increases the time required to change from the austenitic to the pearlitic condition; tungsten and molybdenum and cobalt in presence of chromium will resist the change from the martensitic condition, the first of these, tungsten, if present to the extent of 7 per cent., will entirely prevent the formation of pearlite.

Mo, V and Si (Si up to 3 per cent.) increase the cutting efficiency; Co and U increase the toughness; V decreases the necessary regrindings; W may be replaced by half the quantity of Mo.

#### Analyses of High-Speed Steels.

W	17.65%	5.44	—
Cr	3.76	0.4	12.5
V	0.80	—	—
C	0.68	2.15	1.5
Mn	0.23	1.58	—
P	0.02	—	—
S	0.02	—	—
Si	0.23	1.04	—
Co	2.50	—	3.5
Mo	0.15	—	—

**Semi-High Speed Steels.**

W	7.56	4.78
Cr	3.34	0.69
V	—	—
C	1.19	0.94
Mn	0.46	0.27
P	0.024	0.01
S	0.025	0.01
Si	0.20	0.11
Co	—	—
Mo	—	—

**Chromium Steel.**

Generally contains 0.8-2 per cent. C and 1-2 per cent. Cr, in castings 3-4 per cent. Cr; used for armor-piercing projectiles, rock-crushing machinery, safes, dies, axles, springs, razors, cutlery, also for tool steel and bullet-proof steel.

Stainless steel, used for cutlery, contains 10-13 per cent. Cr, 0.2-0.3 per cent. C, 0.18 per cent. Mn and 0.11 per cent. Si; this alloy is not stainless until heat-treated, tempered and polished, the higher the polish the more resistant will it be to fruit and dilute mineral acids; the resistance to corrosion is tested by immersion in a very strong brine. Several products have been patented as yielding stainless steel: (1) 5-7 per cent. Cr, 0.25-0.75 per cent. Mn, 31.38 per cent. Cu, 38-46 per cent. Ni, 16-20 per cent. Fe. (2) Iron containing 0.2 per cent C, 0.2 per cent. Cu, 0.1 per cent. Mo.

Rustless iron, 13-16 per cent. Cr, 0.1 per cent. C. This is more ductile and more readily machined, forged and rolled than iron. In making this alloy the ferro-chromium used must not contain over 0.5 per cent. C and the expense of this low-carbon ferro-chromium has restricted its use. Marine growths will not adhere to plates of rustless iron.

Thermalloy, 24-26 per cent. Cr, 0.5-0.6 per cent. Mn, 0.8-1 per cent. C, 0.7-0.75 per cent. Si, not over 0.04 per cent. S and P, upon alternate heating and cooling, shows no bending, warping or cracking; does not oxidize below 1175° C. and is less affected above this temperature than any other of the so-called baser metals; the

heat conductivity is over twice that of iron. Used for enamel-burning equipment, carbonizing pots, *etc.*

Duraloy, 27-28 per cent. Cr, 0.5 per cent. Mn, 0.5 per cent. Si, 0.15 per cent. S and 0.15 per cent. P.

Self-hardening steel, 4-6 per cent. Cr, 1 per cent. C and 2-3 per cent. Mn.

Other alloys contain Cr with Ni, Mo, V and W.

### **Manganese Steel.**

Generally contains 11-14 per cent. Mn, 1-1.3 per cent. C, 0.3-0.8 per cent. Si, 0.05-0.08 per cent. P; 1-5 per cent. Mn makes the steel so brittle that it can be pulverized under the hammer; 12-13 per cent. Mn with 1.5-2 per cent. C gives an alloy which on slow cooling becomes almost as brittle as glass but, if heat-treated, becomes as ductile as soft carbon steel with a tensile strength three times as great (the result of heat-treatment differing from other alloys). Manganese steel is non-magnetic and so hard that no tool-steel will cut it, but castings and forgings may be bent and hammered like mild steel; used for jaws and wearing parts of rock-crushing machinery and steam shovels, railroad forges, rails for curves, burglar-proof safes, *etc.*

With a higher percentage of carbon, 6-9 per cent. Mn will give a steel almost equal in properties to the above.

### **Molybdenum Steel.**

Contains 3-12 per cent. Mo, 0.6-1.5 per cent. C, and has practically the same properties as tungsten steel, but only half the quantity of Mo is necessary for same effect. Used in high-speed steel, motor-car steel, boiler plates, crank and propeller shafts, armor-piercing shells, gun barrels; the best permanent magnet steel, 3-4 per cent. Mo and 1-1.5 per cent. C; with Ni and Cr in armor plate.

### **Nickel Steel.**

One of the most important of the structural alloy steels, contains from 3-5 per cent. Ni and 0.1-0.5 per cent. C; Ni is resistant to corrosion, prevents segregation and increases soundness in its alloys.

The alloy most generally used has about six times the life of a carbon steel, and contains 3.5 per cent. Ni, 0.5-0.8 per cent. Mn, and not over 0.04 per cent. of P and S, with carbon varying by 0.05 per cent. from 0.15-0.5 per cent.; properly heat-treated (single or double) combines great tensile strength and hardness with high elastic limit and ductility. Nickel steels are used for armor plate, automobile and bridge construction, rails, ammunition, marine shafting, in fact all kinds of machinery subjected to severe stresses. The addition of small quantities of Cr, 0.3-1 per cent., increases the tensile strength and resistance to wear.

Harveyized steel, for armor plate, contains 3-5 per cent. Ni and 1-2 per cent. Cr, case-hardened.

Self-hardening steel contains 8-25 per cent. Ni.

Resistance wire, 25 per cent. Ni and 0.7-0.9 per cent. C, used in making resistance coils.

Invar, non-expansible alloy, 36 per cent. Ni and 0.2 per cent. C, has the property of maintaining an almost constant volume through a considerable range of temperature, hence used for surveyor's tapes, measuring instruments, pendulums, *etc.*; does not spot with water, takes a fine polish and has a surface on which fine lines can be ruled.

Platinite, 46 per cent. Ni and 0.15 per cent. C, has replaced the platinum in electric-light bulbs because the expansion of this alloy is the same as that of platinum and glass.

Calite, a nickel, aluminum and iron alloy, resists oxidation up to 1300° C.; the protective coating of oxides adheres tightly and does not drop off even on quenching from high temperatures; at 900° C. the loss per sq. cm. is measured in 0.1 milligrams. So hard that it cannot be machined in cast condition, nor cut with oxy-acetylene torch, but must be ground; non-corrosive; immersion in sea-salt solution at 38° C. for 200 hours does not destroy the polish; stainless steel is stated to withstand this treatment but for a few hours.

Copper alloy steel, 1.5-1.8 per cent. Ni, 0.5-0.8 per cent. Cu, and 0.3-0.35 per cent. C, is cheaper but equal to a 3 per cent. nickel steel; with the addition of 0.5 per cent. Cr the properties equal that of a 1 per cent. Cr and 3 per cent. Ni steel.

#### Silicon Steel.

One to five per cent. Si, in presence of the smallest possible amounts of carbon, manganese and other impurities in the iron,

gives an unusually efficient magnet alloy, because of its high permeability and high electric resistance; requires a double and often a third heat treatment. Silicon steel with 2.75 per cent. Si is the most desirable alloy known for electrical generating machinery; with 0.8-2 per cent. Si and 0.7-0.4 per cent. C gives important alloys for the manufacture of springs.

Duriron, 14 per cent. Si, can be cast in any shape, very hard and very brittle, so that it cannot be machined but must be ground; resistant to oxidation and acids; used for sinks, pumps, pipes, *etc.*

Corrosiron, 13 per cent. Si, 0.3 per cent. Mn and 1.2 per cent C.

### Titanium Steel.

Steel containing 0.5-1 per cent. Ti resists abrasion, frictional wear and torsional strains; used for gears, locomotive tires, rails and castings.

### Tungsten Steel.

Self-hardening steel: 4-12 per cent. W, 2-3 per cent. Mn, 1.5-2.5 per cent. C; the Mn may be replaced by 1-2 per cent. Cr and the 12 per cent. W by 4-8 per cent. Mo.

High-speed steel may contain as much as 24 per cent. W with 0.4-0.8 per cent. C; the W may be replaced by one-half the weight of Mo; a small quantity of V is added to advantage.

Magnet steel, 4-5 per cent. W and 0.5-0.7 per cent. C; if heat-treated retains magnetism better than steel.

### Vanadium Steel.

Contains 0.1-0.4 per cent. V, never over 1 per cent. V. Valuable because of its resistance to shocks and stresses; used for pneumatic chisel rock drills, springs, gears, axles, hammer piston rods, aeroplanes, *etc.* Used with W, Cr, Ni, Mo.

0.9 per cent. Cr, 0.12-0.18 per cent. V, 0.15-0.5 per cent. C, 0.65 per cent. Mn and less than 0.04 per cent. S and P gives an alloy superior to nickel steel; with 0.15-0.25 per cent. C can be case-hardened.

**Physical Properties of Alloy Steels.**

The influence of the more important metals used in alloy steels upon the physical properties can be shown in different ways: (1) Alloys prepared to have the same tensile strength and noting the other properties; (2) alloys containing the metals in different quantities, or replacing one metal by another, and noting all of the properties. The character of the heat treatment will considerably change results of physical tests.

(A) Tensile strength, in tons per square inch; (B) elongation in two inches (ductility) in per cent.; (C) reduction in area (toughness) in per cent.; (D) resistance to impact in foot-pounds.

Type of Steel	%C	%Mn	%Ni	%Cr	%Mo	%V	A	B	C	D
Carbon .....	0.62	0.45	—	—	—	—	62.5 to 64	18	40.6	5
Chromium ....	0.49	0.53	—	0.60	—	—		18	56.5	66.5
Nickel .....	0.40	0.53	3.61	—	—	—		18.8	51.4	54.5
Cr, Ni .....	0.43	0.57	1.60	0.46	—	—		19.8	60.3	54
Cr, Mo .....	0.32	0.72	—	0.80	0.27	—	59.25- 81.75	21	68	90
Cr, Mo .....	0.27	0.66	—	0.83	0.42	—		—	—	—
Cr, V .....	0.47	0.85	—	1.19	—	0.15	125	11	38.5	—
Cr, Mo .....	0.41	0.68	—	0.95	0.24	—		9	43.5	—
Cr, Ni, Mo ...	0.44	0.42	2.04	0.99	0.36	—	76	20.5	61	—
Cr, V, Mo ....	0.38	0.60	—	1.00	0.80	0.18	83	18.2	59.7	—
Carbon .....	0.1	0.45	annealed				15-17.5	30-40	55-65	—
Carbon .....	0.4	0.65	annealed				20-25	20-25	40-50	—
"	"	"	heat-treated				22.5-50	5-25	25-50	—

The analytical determinations, given in a previous part of this paper, are now extended to include not only the metals present in the various alloy steels, but also occluded and combined gases. The following statements regarding the gases will be of interest:

A steel made by the basic Bessemer process cast into ingots and allowed to cool in a vacuum yielded gases equal to 2.3 cc. per gram, having the following volume percentage composition:

CH<sub>4</sub>, 0.2; O, 0.9; CO<sub>2</sub>, 3.6; N, 12.7; CO, 30.5, and H, 52.2.

The nitrogen is also present combined as nitride; the determination of the latter is made by dissolving the sample in nitrogen-free HCl, which produces NH<sub>4</sub>Cl, adding the solution to excess sodium hydroxide carefully freed from nitrogen, distilling off the NH<sub>3</sub> and Nesslerizing as in water analysis.

This method applied to the examination of specimens of iron, which in some cases were over a hundred years old with little signs



of corrosion, showed the low nitride nitrogen content, 0.005-0.008 per cent.; tests made with more recent specimens exposed for 1-3 years showed, in cases of failure, 0.014 to 0.041 per cent. N, whereas specimens which showed little or no corrosion gave only 0.004-0.006 per cent. nitrogen, indicating that a high nitrogen content is at least one of the causes of corrosion. The explanations given for the absence of corrosion in some specimens of old iron may be reviewed: These specimens (1) represent a very pure grade of iron, (2) contain the metal copper in small quantity, and (3) contain a minimum quantity of combined nitrogen.

### REFERENCES.

- Harrison Hale, "American Chemistry," D. Van Nostrand Company, 1921.  
A. Rogers, "Industrial Chemistry," D. Van Nostrand Company, 1921.  
A. S. Cushman and H. A. Gardner, "The Corrosion and Preservation of Iron and Steel," McGraw-Hill Book Company, Inc., 1910.  
W. Rodenhauser, J. Schoenawa and C. H. Von Baur, "Electric Furnaces in the Iron and Steel Industry," John Wiley & Sons, Inc., 1920.  
Report of the International Committee on Testing Materials, *Chemical Engineer*, 1917.  
L. Guillet and A. Portevin, "Metallography and Macrography," G. Bell & Sons, Ltd., 1922.  
E. Oberg and F. D. Jones, "Iron and Steel," The Industrial Press, 1918.  
E. F. Law, "Alloys and Their Industrial Applications," Charles Griffin & Co., Ltd., 1909.  
E. M. Chamot, "Elementary Chemical Microscopy," John Wiley & Sons, Inc., 1921.  
"Research and Methods of Analysis of Iron and Steel," The American Rolling Mill Co., Middletown, O., 1920.

## ABSTRACTED AND REPRINTED ARTICLES

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### FORENSIC CHEMISTRY IN THE PUNJAB.

The report of Lieut. Col. J. A. Black of the Royal Medical Service on the work of the Chemical Laboratory of the Punjab gives a vivid and interesting insight into the problems that are encountered by a chemist in a mixed population of Hindus and Mohammedans. The Punjab is a district in northwestern India stretching from the foothills of the Himalayas to a comparatively low land. It is watered by the Indus, of which there are five tributaries. The name is derived from a Hindu word meaning "five." Notwithstanding these rivers, the majority of the district is hot and dry, especially from April to September. The area is about 136,000 square miles, somewhat smaller than the State of Montana. The population is about 20,000,000, of which about half are Mohammedans and the greater portion of the remainder Hindus.

The characteristic of the chemical work in this laboratory is examinations in cases of poisoning. Homicidal and suicidal poisonings are extremely common. Suicides often occur from what would be considered in other countries as very trifling motives. Homicidal poisoning is occasioned by about the same class of motives that are active elsewhere. Accidental poisonings, due to ignorant use of dangerous drugs or the negligence of drug vendors, are also more frequent than in Europe and America. Arsenic is very largely used, on account of the resemblance of its symptoms to those of cholera, a disease often very prevalent in the district. Opium and Datura-seeds are also frequently used, the former mostly for suicide and infanticide, the latter for drugging food or drink, to aid in commission of robbery. An account is given of the methods of the Thags (commonly known in English as "Thugs"), who mostly use datura-seeds. Aconite is also used in the places in which it is found. These four poisons cover about 90 per cent. of the cases of poisoning found in the Punjab. In consequence of this limitation, the task of the toxicologist is comparatively simple. A notable difference exists between the manner in which the expert evidence is given in India and in western nations. The India chemist is comparatively rarely required to appear in court. He makes a written

report, which is read. He is, therefore, not subject to cross-examination. Dr. Black inclines to favor this method, though he acknowledges that it is not without defects. As a matter of fact, it is a highly objectionable method, but it has been adopted largely because of the great extent of the district over which the expert's duties extend. Crime is greater in proportion to the population than in more highly civilized countries—at least, detected crime is greater—and personal attendance on trials would require a large body of chemists.

Physiologic methods of detecting poisons are necessary in many cases, and it is interesting to read the statement that the animals are treated with as much care as possible. This observation is probably meant to avoid any criticism from that numerous and influential portion of the British public opposed to animal experimentation. Blood differentiation is, of course, not infrequently required. The precipitin tests have been found satisfactory, and the application of them has led to conviction in a number of cases. A case is described in which a stain was shown to be a mixture of camel's and human blood, the former identified by the shape of the red corpuscles, materially different from ordinary mammal blood, and the latter detected by the precipitin test.

The work of the laboratory is by no means limited to the toxicology field. Food adulteration is extensive. A special and dangerous line is the examination of explosives in packages and letters. During the war, many articles of household use were seized by the authorities under the suspicion of being intended for employment against the government, so that a curious and miscellaneous collection of articles was referred to the chemist. As might be expected, illicit drugs are often found, especially cocaine. Drugs of this type, found to be of good quality, are turned over to the medical authorities. A good deal of the illicit importation of cocaine was in German hands before the war. The use had reached such extensive development that there was at one time in the laboratory confiscated material, the money value of which at the ordinary bazaar rates was estimated at about \$160. A great variety of problems not connected with medical matters have also been considered in the laboratory, such as the best method of waterproofing fabrics for troops, the cause and prevention of corrosion of copper plates in boilers, the amount of barium carbonate required to poison rats, for prevention of spread of plague, and whether a certain antiseptic preparation could be safely used in water.

The government has recently improved the laboratory very much, having spent about \$50,000 in new buildings and equipment. Dust is very much of an annoyance, and it is intended to sink a well for the express purpose of aiding in the development of lawns and the raising of trees so as to overcome this annoyance and also to beautify the grounds. The laboratory was located at Lahore about sixty years ago, primarily to deal with the criminal incidents among the native population. Cases of poisoning are by no means limited to human beings. Domestic animals are often victims. A peculiar method of animal poisoning is often noted. Seeds of *Abrus precatorius* are pounded and made into a paste with water. The paste is shaped in a narrow, pointed, needle-like form, which when quite dry becomes very hard. It is fitted into a small cavity in a bamboo stick, which serves as a handle, pushed under the skin of the animal and the handle removed. An intense local inflammation is soon set up, which results in the death of the animal in a few days if the wound is not detected in time and the mass removed.

H. L.

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#### LIMITS OF ACCURACY IN DISPENSING.\*

On May 1st, F. O. Finn appeared at the South-Western Police Court to answer a summons by the Battersea Borough Council for selling a compound drug deficient in potassium iodide to the extent of 17 per cent.

Mr. C. A. Hackman, Public Analyst for Battersea, stated that the prescription was: "Potassium iodide, 5 grains; liquor hydrargyri perchloridi,  $\frac{1}{2}$  dram; chloroform water to  $\frac{1}{2}$  an ounce. Send 8 ounces of the mixture;  $\frac{1}{2}$  ounce to be taken 3 times a day."

He found that each fluid  $\frac{1}{2}$  ounce contained 4.15 grains of potassium iodide, or the whole sample 66.4 instead of 80 grains, which would mean a daily deficiency of 2.6 grains. In his opinion, the error was greater than should arise in the ordinary course of dispensing practice.

In cross-examination, he agreed that the B. P. allowed a purity of 98 per cent. of potassium iodide. His certificate was based on a purity of 100 per cent., which would reduce the deficiency in the

\*Reprinted from *The Analyst*.

sample of 15 per cent. He had estimated the mercuric chloride colrimetrically and judged it to be correct. His laboratory balance was sensitive to  $\frac{1}{10}$  milligram, and he would expect a pharmacist's scales to be correct to at least  $\frac{1}{4}$  grain. When analysing such prescriptions he would allow a margin of error of 10 per cent., though a good pharmacist should work to within 5 per cent. The size of the bottle should have nothing to do with the error. The mixture should be made in a measure. He could not agree that what the doctor meant was that the ingredients should be put into "reputed" 8-ounce bottle.

Dr. G. Q. Lennane, Medical Officer of Health, Battersea, stated that he considered the error in this case, avoidable and due to careless dispensing. Even if he were unable to observe any difference between the action of  $4\frac{1}{4}$  grains and 5 grains, he would object if the exact quantity were not given.

Mr. Glyn-Jones, counsel for the defence, suggested to this witness that it was not usual to put " $\frac{1}{2}$  ounce three times a day." The average patient did not know what half an ounce was, and so it was usual to say a tablespoonful. As tablespoons varied, would it not have been more accurate to say one-sixteenth part? If 80 grains of potassium iodide and 1 ounce of mercury perchloride liquor had been put in and the bottle then filled up with chloroform water, there would have been no ground for complaint.

He submitted that the analyst's certificate must give full particulars and contain such data as would enable the Court to judge what offence had been committed. There was no standard of accuracy to which they could adhere (the Magistrate here disagreed, saying "We have been told that there are 4.15 grains instead of 5.0"). They were not told what was the composition of what was sold. It was quite possible that the proper quantity of potassium iodide was present, and that there was too much water, in which event it should have been treated as a case in which a foreign ingredient was present. As regards a single ingredient being deficient, the analyst had admitted that there was a standard which the certificate did not mention, and that that standard reduced the deficiency by 2 per cent. If a standard existed the analyst must say on his certificate that he was aware of that standard, and that he based his calculations in reference to it. For aught that appeared on the certificate the analyst might not have known of the B. P. standard. The

proper form of certificate dealing with this particular point should contain the words "satisfying the requirements of the British Pharmacopœia."

Medical evidence was then given to the effect that although three-quarters of a grain was an inaccuracy, it was not of great importance. If the right ingredients were put in the bottle it was perfectly safe to fill it up with water. There was a great variation in common tablespoons, and to take one-sixteenth part was more accurate. A pharmacist also gave evidence that, owing to variations in the sizes of bottles, he regarded the method of mixing the ingredients in the bottle as the common sense way, and as more desirable.

Mr. Glyn-Jones, in concluding his argument, said that his contention was that the purchaser intended that the prescription should be made up according to the accepted practice, a practice accepted both by doctors and pharmacists. There was no evidence that the purchaser did not get the doses the doctor prescribed. The analyst had admitted that an inaccuracy of 10 per cent. was permissible. He submitted that there was some doubt whether it was possible to measure without error. The prosecution would not contend that 100 per cent. efficiency was possible, and the question was where did "de minimis" begin to operate. Another point was that possible variations in the size of the bottles would account for an error of at least 5 per cent.

The Magistrate (Mr. Marshall) said that he did not agree with the arguments of Mr. Glyn-Jones. He thought that sufficient care had not been taken in dispensing this prescription, and imposed a fine of 40s., with £3 3s. costs.

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### FROM THE LOG OF AN ANCIENT CRAFT.

(Reprints from Old Issues of the AMERICAN JOURNAL OF PHARMACY.)

Philadelphia, March 21, 1882.

In the absence of the President, Mr. Wm. J. Jenks was called to the chair. The minutes of the last pharmaceutical meeting were read and approved.

Prof. Power read a paper upon homatropine (see page 145). In answer to a question as to what extent homatropine was at present used in medicine, Dr. Wolff stated that it had not by any means supplanted the older remedy, atropine.

Prof. Maisch, on behalf of the British Pharmaceutical Con-



ference, presented a copy of the "Year-Book of Pharmacy for 1881," and, from the Pharmaceutical Society of Great Britain, a copy of the Calendar of their society for the year 1882.

Prof. Maisch exhibited specimens of a now quite rare drug, namely, the American *Castor*, with oil sacks, attached thereto; these were much fresher than the drug is usually seen in the market, and had a strong castor and smoky odor, the sacks having been partially dried in the smoke. They had been sent by Mr. C. R. Lange, of Scribner, Neb., a graduate of the College.

A query was put as to whether any present were familiar with *chlorinated oil*. In reply Dr. Wolff stated that he had prepared it by passing dry chlorine gas into olive oil, and that, to his surprise, the gas was absorbed to a large amount; that there was a very considerable rise in the temperature of the oil, but there was no acid reaction nor smell of chlorine upon the oil. This chlorinated oil has been used quite successfully in cutaneous affections. Prof. Maisch suggested that an acid reaction would probably be observed on washing the oil with water; at least Lefort had, in 1852, obtained chlorine substitution compounds by treating fats with moist chlorine. Prof. Sadtler stated that he had prepared such substitution compounds of the fatty acids, and the soaps could be made with such acids.

Mr. Trimble called the attention of the meeting to an adulteration which was new to him, *viz.*, that of *extract of liquorice* with extract of logwood; he had endeavored to get a sample of the sophisticated article, but so far had been unable to do so. Mr. Brown stated that he had lately seen an article of powdered extract of liquorice, which, upon attempting to dissolve for the purpose of making brown mixture, proved to be refractory, and examination showed it to be largely contaminated with wheat starch; the article was represented to be of German origin. Prof. Maisch considered this latter statement doubtful, since in that country starch was largely prepared from potatoes, and this was doubtless cheaper there than wheat starch.

Prof. Sadtler presented a copy of a table of the *scales of Baume's hydrometer*, the results of some very careful examinations into the original papers upon the subjects, made by Prof. C. F. Chandler and one of his assistants; and also a table of the valuations of *sulphuric acid* of different degrees of the hydrometer scale.

There being no further business, a motion to adjourn was made and carried.

T. S. WIEGAND, Registrar.

USES OF CHAULMOOGRA OIL IN SKIN DISEASES.—A foreign exchange says chaulmoogra oil, which has obtained a certain reputation in India for the amelioration of the symptoms—I will not say the cure—of leprosy, has been introduced into this country with the somewhat vague reputation of being useful in skin diseases. It has answered well in some cases of eczema of the face, which had passed the moist stage and tended to become dry. It seems to act as a mildly stimulating astringent, but its applicability is certainly limited, and experiments with it in Germany, recently reported, have not increased its reputation. It is in the strumous forms of eczema of the face in children and young persons that the best results from its use have been attained.—*Med. and Surg. Reporter*, November 26, 1881 (*A. J. P.*, 1881).

EDITOR'S NOTE.—It is highly interesting to note in the foregoing paragraphs the significant, if empiric, announcement of the therapeutic value of chlorinated oil and chaulmoogra oil, the former as a germicide, and the latter as a leprosy remedy. These two drugs have come to us again recently, much heralded, as new and effective therapeutic weapons and the twentieth century claimed the honor of their introduction. And yet in the log of an old craft is the story of captains of other days looking to horizons dim and marking on their printed scrolls the lasting record of their findings. Verily many of the accomplishments of today are but the echoes of deeds already done by vanished hands.

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## SCIENTIFIC AND TECHNICAL ABSTRACTS

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PREPARATION OF METHYL ACETATE FROM METHYL OXALATE.—Methyl oxalate may be obtained in high purity from commercial methyl alcohol even when the latter contains ethyl alcohol, while methyl acetate cannot be so easily prepared. Small quantities of the acetate being often required in physico-chemical work, E. E. Turner, D. Sc., and F. H. H. Wilson investigated the reaction of acetic acid of several strengths upon the oxalate, and found that with an acid of 65-70% nearly complete conversion of the oxalate into acetate occurs. They give an account of their investigation in *Journal and Proceedings of the Royal Society of New South Wales* (1921, Vol. 55, 63). The procedure is described as follows: One

molecular proportion of methyl oxalate, two of glacial acetic acid and two of water are heated with reflux condenser for three hours. The yield is about 80% of the theoretical. Further research will be needed to determine the optimum concentration of the acid, and the extent to which the reaction is applicable as a general method for preparing esters. So far as the work has gone, it has indicated that a definite hydrate (containing one molecule of water) seems to be most efficient.

H. L.

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A NEW ESSENTIAL OIL.—A. R. Penfold, F. C. S., describes in the 55th (1921) volume of the *J. and P. of the Roy. Soc. of N. S. W.*, an essential oil derived from *Leptospermum flavescens* Smith (Myrtaceae). The plant is a shrub from four to twelve feet in height, growing abundantly in the coastal and mountain districts of S. E. Australia. It and some of its associated species are known locally as "Tea trees." Penfold operated on about 1210 pounds of the leaves collected from several localities and found an average yield of 0.8%. The principal constituents so far determined are:

A dextro-rotary sesquiterpene alcohol, eudesmol, both in solid and liquid form.

A mixture of two dextro-rotary sesquiterpenes, probably eudesmene and aromadendrene.

Alpha- and beta-pinene.

A liquid phenol that gives an orange red with tincture of chloride.

Citral.

Small amounts (not over 5%) of unidentified alcoholic substances.

Penfold considers the oil suitable for some industrial purposes.

H. L.

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## MEDICAL AND PHARMACEUTICAL NOTES

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ILETIN (INSULIN).—The eyes of the medical world are at the present time turned with much interest to the new treatment for diabetes, an active pancreatic extract which controls carbohydrate metabolism. Insulin, the name given to this product by its discoverers, Dr. F. G. Banting and C. H. Best, working in the laboratories of

Professor J. J. MacLeod, of Toronto University, represents an epoch-making event in the history of medicine.

To Eli Lilly & Company was accorded the privilege of working out the research problems involved in large-scale production. Through close co-operation, a method was developed whereby in a few months a highly-purified, stable product was produced in sufficient amount to start extensive clinical experiments.

The Insulin Committee of the University of Toronto, in the *Journal of the American Medical Association*, for June 23, 1923, on page 1850, states in part: "Since, however, a large-scale method had not been sufficiently evolved to insure a product of constant potency, it was decided before issuing licenses to manufacturers to develop the details of such a method. At the same time it was realized that adequate facilities for doing this on a practical manufacturing scale could not be provided for unless by collaboration between the Committee and some highly organized firm or firms engaged in the manufacture of animal extracts of similar nature. And since it was also evident that such collaboration could not be carried out satisfactorily with several firms at one and the same time, it was decided after careful consideration to invite the Eli Lilly Company, of Indianapolis, to send representatives to Toronto to confer on the question.

"Through the whole-hearted collaboration of the University and The Eli Lilly Company, and the valuable assistance of its scientific adviser, Dr. G. H. A. Clowes, large-scale production of Insulin has been carried forward at a satisfactory speed."

The purified product from the Indianapolis laboratories was given the name Iletin (Insulin, Lilly), and with the approval of the Toronto investigators was submitted to a group of diabetic specialists in the United States for clinical trial. Very rapid progress was made in improving the preparation and determining the best means of using it clinically.

Iletin cannot be considered a cure for diabetes in the strict sense of the word. Its real value is in fact that it enables the diabetic patient to utilize carbohydrates in a normal manner, to regain health and strength and maintain normal activity as long as the use of the extract is continued.

Iletin is supplied to physicians in 5 cc. ampoules and in two strengths: H-10, containing 10 units per cc. and H-20, containing 20 units per cc. or 100 units per ampoule. It is injected subcutaneously, one, two, or three times daily, in definite relation to the meals.

A danger to be avoided in the administration of this very potent extract is the production of hypoglycemia—the lowering of the blood-sugar below the normal level (100 mgs. per 100 cc. of blood, or 0.10 per cent.). In every instance Iletin should be administered only under the direction of a physician competently informed on the product and its use.

Every pharmacist is interested in Insulin, referred to as the "greatest discovery in medicine in fifty years." Its distribution through the retail trade means much to the recognition of the part the pharmacist should have in the handling of medicinal products and places the pharmacist in closer touch with the medical profession.

The Insulin Committee of the University of Toronto, in an article in the *Journal of the American Medical Association* recently, reported as follows: "The Insulin Committee desires to express its appreciation of the whole-hearted manner in which the Lilly research laboratories have co-operated in working out the problems of large-scale production of Insulin. Without this collaboration it is unlikely that a non-irritating product of such satisfactory potency and durability could have been produced in adequate amounts to meet the demand of the medical profession, in this comparatively short time."

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## BOOK REVIEWS

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THE RECOVERY OF VOLATILE SOLVENTS. By Clark Shove Robinson, Assistant Professor of Chemical Engineering at the Massachusetts Institute of Technology. 188 pages. Illustrated. \$2.50. Chemical Catalogue Company, Incorporated, New York.

Though technical literature, particularly that pertaining to patents, is full of references to the recovery of volatile solvents in industry, this is claimed by the author to be the first book which deals exclusively with the subject. He says he has made a search of the literature covering the past forty years and has culled therefrom the most valuable portions and incorporated the gist of them in his book.

In addition, he has given 218 short abstracts which should prove of great value, particularly, to engineers who are called upon to design apparatus.

A list of forty-five solvents, with their several chemical formulas, latent heats of vaporization, heats of solution, specific gravities, and boiling temperatures in degrees C. at different pressures (in millimetres), should be helpful to many.

The illustrations, seventy-three in number, are in part of apparatus and partly diagrammatic plottings of data.

Of the twenty-four chapters, six are devoted to elementary principles involved in solvent recovery, five to the application of solid absorbing agents to solvent recovery, nine to recovery of vapors by condensation (by cooling or pressure, or both), three to scrubbing by means of liquids, and one to extraction by solvents.

The book would seem to have a fairly large field of usefulness, particularly among manufacturers and engineers concerned with processes involving the use of large quantities of volatile liquids as solvents.

F. P. STROUP.

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### THE PHARMACIST.

Behold the sage, who has the skill to mix  
Hydrarg. and sulphur with q. s. cold cream;  
Or yet, perchance, in Chartæ neat to fix  
The aspirin. His life is one long dream.

Fol. Cocæ give his shop a foreign air,  
And Jaborandi on his shelves is seen;  
Bottles and boxes too, with labels fair—  
Tinct., Aqua., Pulv., and many more, I ween.

Here is sweet marjoram, but by its Latin name,  
(For Latin still is needed in this field),  
And Peru Balsam and Tolu—almost the same—  
And salts of lime that bring but little yield.

And then the scales (called "balance" by the elect)  
On which the potent drugs are duly tared.  
"Ah," says the master. "We must sure expect  
That even wise men may by decimals be scared."

"If it were not for us who know in what to look,  
The man of law and he who bears the sword  
Would both be lost. 'Tis in thy pages, great official book,  
Revised and re-revised, that we can find the Word."

H. L.

(A liberal translation  
from the French.)